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EIN FALL VON ECLAMPSIE OHNE NIERENAFFECTION.

INAUGURALDISSERTATION

WELCHE

ZUR ERLANGUNG DER DOCTORWUERDE

IN DER

MEDICIN, CHIRURGIE UND GEBURTSHUELFE

UNTER ZUSTIMMUNG DER MEDICINISCHEN FACULTAET ZU KIEL,

NEBST DEN BEIGEFUEGTEN THESEN

OEFFENTLICH VERTHEIDIGEN WIRD

FRIEDRICH SCHULZ

AUS FLENSBURG.

KIEL.

DRUCK VON C. F. MOHR.

1867.

C

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Litzmann,
d. Z. Decan.

Die Eclampsie ist einer der störendsten und schrecklichsten Zufälle, welche während der Geburt oder im Wochenbette auftreten können. Es ist dieses um so trostloser, weil wir uns gestehen müssen, dass unsere Kenntniss von der Ursache, wiewohl durch manche Aufschlüsse neuerer Forschung bereichert, dennoch immer eine ungenaue ist, dass es offenbar Fälle giebt, denen eine andere Ursache als die bisher angenommene zu Grunde liegt, und wiederum andere, wo der Zusammenhang mit dem ursächlichen Leiden unklar bleibt, indem die geringfügigen anatomischen Veränderungen zur Erklärung so schwerer Symptome, wie die Eclampsie sie uns darbietet, scheinbar ungenügend und unverwerthbar sind. Die allgemein verbreitetste Ansicht ist die, dass ein Nierenleiden der Eclampsie zu Grunde liege. Der englische Geburtshelfer Lever war der Erste, welcher auf die Nieren hinwies, indem er die Beobachtung machte, dass in allen von ihm behandelten Fällen von Eclampsia parturientium schon während der Schwangerschaft oder doch während der Geburt Eiweiss im Urin sich finde (1843). Später ist diese Thatsache von anderen Männern, wie Devillers und Reynauld, Frerichs, Litzmann, Braun, bestätigt worden, welche ausserdem noch Fibrincylinder im Harn entdeckten. Die Art des Nierenleidens und namentlich die Weise, wie die Eclampsie von demselben abhängig sei, ist bis auf die Gegenwart ein streitiger Punkt geblieben. Lange hielt sich die Ansicht, dass der morbus Brightii das fragliche Nierenleiden sei, und die Eclampsie bei ungenügender Harnausscheidung in Folge Retention von Harnbestandtheilen im Blute entstehe, wie wir auch dieselben Zufälle, epileptische Convulsionen, Coma, aus dem nämlichen Grunde bei Bright'schen Kranken entstehen sehen.

Niemeyer unterscheidet eine parenchymatöse Nephritis und eine parenchymatöse Degeneration der Nieren (Siehe dessen Lehrbuch d. Pathol. u. Therap. pag. 15 und 37), welche letztere während der Schwangerschaft am häufigsten beobachtet werden soll. Dieser Autor sagt: „Die parenchymatöse Nephritis unterscheidet sich, obgleich auch in ihrem Verlaufe die Epithelien der Harnkanälchen anschwellen, fettig entarten und zerfallen, sowohl durch die Intensität und die Ausbreitung des Processes,

als durch die Selbstständigkeit und die unverkennbar entzündliche Natur desselben so deutlich von der in Rede stehenden Ernährungsstörung, dass es sich verbietet, beide Krankheitsformen zu identificiren. Ebenso ist die Annahme, nach welcher die parenchymatöse Degeneration der Niere — wie wir die in Rede stehende Entartung in Ermangelung eines besseren Namens nennen wollen — durch eine Hyperämie bedingt ist, unerwiesen und unwahrscheinlich".

Andererseits ist aber auch die Urämie, welche man als Folge des Nierenleidens und nächste Ursache der Eclampsie anzusehen hat, ein Gegenstand zahlreicher, zum Theil einander widersprechender Untersuchungen geworden. Dieselben haben zur Aufstellung einer Menge Theorien geführt, indem bald diese, bald jene Harnbestandtheile oder deren Zersetzungsprodukte als das Blut vergiftendes und schwere Störungen von Seiten des Nervensystems hervorrufendes Princip verdächtig gemacht wurden. Als die wichtigsten verdienen zunächst folgende angeführt zu werden:

Der Erste, welcher die Urämie von einer Vermehrung des Harnstoffes im Blute abhängig machte, ist Arthur Wilson. Er nimmt zwei Factoren an, durch welche nur die Nervenerscheinungen in der Urämie erklärt werden könnten, nämlich eine Verminderung des Albumins und eine Vermehrung des Harnstoffes. Frerichs nahm an, dass der Harnstoff ein unschädlicher Stoff sei, dass dahingegen das durch ein unbekanntes Ferment im Blute erzeugte Umsatzprodukt des Harnstoffes, das kohlensaure Ammoniak, die genannten Erscheinungen hervorrufe. Es solle eine Injection von kohlensaurem Ammoniak in das Blut eine Reihe der Urämie ähnlicher Symptome hervorrufen und kohlensaures Ammoniak im Magen, im Erbrochenen, sowie auch in der exspirirten Luft nachzuweisen sein. Desgleichen glaubt Schottin[1]), dass die Urämie nicht durch eine Anhäufung von Harnstoff im Blute bedingt sei. Der Harnstoff sei ein indifferenter Stoff, er mache aber das Blut indifferent, verhindere dadurch die Umwandlung der Extractivstoffe, welche nur in alkalischem Blute vor sich gehen könne, und bewirke eine enorme Ansammlung derselben im Blute (das normale Verhältniss der Extractivstoffe und der Eiweisskörper 5 : 100 verändern sich in 40 : 100) und in der Folge urämische Erscheinungen. Dass ausser dem Harnstoff auch andere Umsatzprodukte und Zersetzungsprodukte, wie Milchsäure, in den Geweben zurückbleiben und urämische Erscheinungen hervorrufen, findet Buhl[2]) bei dem Choleratyphoid, wo die Nieren gesund gefunden werden, wo aber wegen der in Folge der enormen Wasserentleerung durch den Darm entstandenen Eindickung des Blutes jene Endprodukte des Stoffwechsels von demselben gleichsam nicht weggespült und den Nieren nicht

[1]) Beiträge zur Charakteristik der Urämie. Vierordt's Archiv für physiolog. Heilkunde. XII. Jahrg. pag. 170. 1853.

[2]) Mittheilungen aus der Pfeuffer'schen Klinik. — Epidemische Cholera. — Zeitschrift für rationelle Medicin. Th. VI. 1855.

zugeführt werden können. Gallvis[3]) fand bei Versuchen an Kaninchen, dass, wenn er Harnstoff in den Magen injicire, derselbe durch den Harn wieder ausgeschieden würde, dass grössere Gaben für diese Thiere ein tödtliches Gift seien, dass sie alle unter denselben Symptomen stürben, und dass kohlensaures Ammoniak in dem Athem derselben nicht nachzuweisen sei. Auch Hammond[4]) zieht aus seinen Untersuchungen den Schluss, dass der bis zu einem gewissen Grade im Blute angehäufte Harnstoff, nicht aber dessen Zersetzungsprodukt, das kohlensaure Ammoniak, die Erscheinungen der Urämie hervorrufe. Er fand ferner, was auch Andere bestätigt haben, dass, so lange der Harnstoff oder seine Produkte durch den Darm entleert würden, keine Urämie auftrete. Oppler[5]) fand nach Exstirpation der Nieren und nach Unterbindung der Ureteren an Thieren die Harnstoffmenge im Blute vermehrt, nach letzterer Operation aber in weit grösserem Maasse, doch fanden sich auch die Extractivstoffe beträchtlich vermehrt. Er folgerte hieraus, dass der Harnstoff zum geringsten Theil in den Geweben gebildet werde, sondern dass er als solcher noch nicht völlig entwickelt zu den Nieren gelange und hier erst seine Umwandlung in Harnstoff erfahre. Kohlensaures Ammoniak hat Oppler weder im Blute noch in den Geweben nachweisen können. Traube[6]) sieht ganz von einer urämischen Intoxication ab, lässt aber den sogenannten urämischen Symptomencomplex aus einer Anämie und Hydrops des Gehirns hervorgehen, welche einer Hydrämie und erhöhtem Blutdruck im Aortensystem ihre Entstehung verdanken. Auch Munk[7]) findet nach aufgehobener Harnsekretion nur Harnstoff, nie aber kohlensaures Ammoniak im Erbrochenen; im Uebrigen findet durch ihn die Traube'sche Hypothese eine Bestätigung, indem er nach Unterbindung der vena jugularis und Injection von Wasser in die Carotis bei verschlossenen Ureteren urämische Zufälle eintreten sah. Durch Perls'[8]) Untersuchungen findet Oppler's Ansicht eine neue Stütze; er zieht aus demselben den Schluss, dass der Harnstoff seine Bildungsstätte in den Nieren habe; dass bei ungenügender Nierenthätigkeit die Extractivstoffe, namentlich das Kreatin, in den Geweben sich anhäufen. Neuerdings sind wiederum von Zalesky[9]) umfassende Untersuchungen über diesen Gegenstand vorgenommen worden, um die Wirkung der Extirpation der Nieren und

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[3]) Experiences sur l'urée et les urates. — Compt. rend. de l'Acad. des sciences. Avril 1868. No. 14; Gaz. des hôpitaux 45. 1858.

[4]) On the Injection of urea and other substances into the blood. North Americ. Med. chirurg. Review II. pag. 287. March. 1858.

[5]) Beiträge zur Lehre von der Urämie. — Virchow's Archiv Band 21. pag 260.

[6]) Ueber die sog. urämischen Anfälle. — Med. Centr.-Ztg. XXX. pag. 103. 1861.

[7]) Zur Frage von der Urämie. Berlin, klinische Wochenschr. 1864. No. 11. p. 18.

[8]) Königsberger medic. Jahrbücher Bd. IV. pag. 56.

[9]) Untersuchungen über den urämischen Process und die Function der Nieren. — Tübingen, 1865.

der Unterbindung der Ureteren an Thieren zu prüfen und mit einander zu vergleichen. Er benutzte Hunde, Vögel und Schlangen zu seinen Versuchen, welche letzten beiden Thierklassen keinen Harnstoff, sondern harnsaure Salze durch die Nieren ausscheiden. Bei Hunden traten nach beiden Operationen urämische Erscheinungen auf und zwar zuerst Erbrechen. Das Erbrochene reagirte constant sauer. In der exspirirten Luft war keine Vermehrung des Ammoniaks nachzuweisen. Bei der Section fanden sich weder Spuren von Meningitis oder Oedem des Hirns, noch seröser Erguss in die Ventrikel. Nach der Nephrotomie war die Harnstoffmenge des Blutes nicht vermehrt, dahingegen fand sich eine sehr beträchtliche Vermehrung dieses Stoffes nach der Unterbindung der Ureteren, und zwar nicht allein im Blute, sondern in allen Flüssigkeiten und festen Geweben des Körpers. Eine Vermehrung des Ammoniaks im Blute war nicht bedingt durch die Vermehrung des Harnstoffes; es blieb nach beiden Operationen der Ammoniakgehalt des Blutes derselbe. Der Kreatingehalt der Muskeln war nach der Nephrotomie bedeutend grösser als in der Norm. Bei Vögeln fand er nach Unterbindung der Ureteren eine massenhafte Ablagerung von harnsauren Salzen in allen Geweben des Körpers: zuerst im Lymphgefässsystem, dann im Blute und schliesslich auch in und auf allen festen Organen. Ungeachtet, dass kein Harnstoff, folglich auch kein kohlensaures Ammoniak von diesen Thieren gebildet wird, sondern nur harnsaure Salze durch den Urin ausgeschieden werden, treten dennoch die Symptome der urämischen Intoxiation auf. An Schlangen wurden beide oben genannte Operationen ausgeführt; die Resultate zeigten sich verschieden, entsprechend den bei Hunden gewonnenen, insofern wiederum die Nephrotomie eine spärliche, nur auf den unteren Theil der Bauchhöhle beschränkte Ablagerung von harnsauren Salzen zur Folge hatte, während dieselbe nach Unterbindung der Ureteren reichlich über alle Organe verbreitet war, und auch in den Gelenken stattgefunden hatte. Die chemische Analyse ergab, dass die Menge der abgelagerten harnsauren Salze nach Unterbindung der Ureteren sechs Mal grösser sei als nach Exstirpation der Nieren. Aus seinen Versuchen zieht Zalesky folgende Schlüsse: Der Harnstoff an und für sich bewirkt keine urämischen Erscheinungen, weil dieselben auch auftreten bei Thieren, welche keinen Harnstoff produciren; es müsste denn der Harnsäure die gleiche Wirkung wie dem Harnstoff zugeschrieben werden. Nach Exstirpation der Nieren nimmt die Harnstoffmenge des Blutes nicht oder doch nur unbedeutend zu, nach Unterbindung der Ureteren aber ist die Vermehrung desselben beträchtlich: dennoch treten die Symptome der Urämie ungefähr in gleichem Zeitraum nach der Operation ein. Der Kreatingehalt der Muskeln nimmt ausserordentlich zu, mehr nach Exstirpation der Nieren als nach Unterbindung der Ureteren. Der Harnstoff im Blute hat nach Unterbindung der Ureteren weit mehr zugenommen als nach der Exstirpation der Nieren. Dasselbe Resultat zeigte sich bei Schlangen in Bezug auf die Harnsäure. Es folgt hieraus, dass der Harnstoff und bei gewissen Thieren die Harnsäure nur in

geringen Spuren in den Geweben vorhanden, erst in den Nieren gebildet werden. Es wird hierdurch die Oppler'sche Ansicht bestätigt: Die Nieren scheiden nicht nur den Harnstoff aus, sondern sind vielmehr seine Bildungsstätte. Zalesky lässt es unentschieden, welcher Stoff bei ungenügender Harnausscheidung die urämischen Zufälle verursache; es werde der Befund an Kreatin, Harnstoff oder die Spannung des Blutes (Traube's Hypothese) verschieden ausfallen können, je nachdem ein mechanisches Hinderniss des Abflusses oder eine Störung des Umsatzes in der Niere vorliege. Durch die Untersuchungen von Zalesky ist keine Vermehrung des Ammoniaks in Folge einer Zersetzung des Harnstoffes im Blute oder in den Geweben gefunden worden. Die von Frerichs aufgestellte Theorie, dass das kohlensaure Ammoniak die Erscheinungen der Urämie hervorrufe, ist, von den meisten Forschern widerlegt, weil eine Vermehrung des Ammoniaks im Blute oder in den Geweben nie nachgewiesen wurde, jetzt fast allgemein verlassen.

Bei dem jetzigen Stande der Untersuchungen über das Wesen der Urämie müssen wir uns damit begnügen, nach der verbreitetsten Ansicht anzunehmen, dass die Eclampsie auf einer Anhäufung von Harnbestandtheilen im Blute in Folge eines während der Schwangerschaft akut sich entwickelnden Nierenleidens beruhe, und einen Theil des eigenthümlichen Symptomencomplexes ausmache, welchen man als Urämie bezeichnet hat.

Die Rosenstein'sche Theorie, nach welcher die Eclampsie mit der Urämie Nichts zu schaffen habe, sondern auf einer in Folge von Hydrämie und erhöhter Spannung im Aortensystem entstandenen Anämie und Oedem des Hirns (Traube's Theorie d. Urämie) beruhe, ist von Hecker im 24. Band der Monatsschrift f. Geburtskunde widerlegt worden. Dass aber unzweifelhaft die Eclampsie auch auf eine bis jetzt unbekannte Weise als durch urämische Intoxiation entstehen könne, zeigt der in eben demselben Bande d. Monatsschr. f. Geburtskunde von Dohrn mitgetheilte Fall. Die Kreissende hatte sich während ihrer Schwangerschaft stets wohl befunden. Die Harnstoffausscheidung ging während der Eclampsie in genügendem Maasse von Statten. Die erste 24stündige Harnmenge betrug 760 C. Ctm., welche 19,76 Grmm. Harnstoff, die zweite 950 C. Ctm., welche 32,3 Grmm. enthielten. Vor der Eclampsie war kein Eiweiss im Harn, es trat erst nach den Convulsionen auf und nahm mit ihnen zu. Die Nieren wurden bei der Section ganz normal gefunden. Vor Kurzem ist in der Kieler Gebäranstalt ein Fall von Eclampsie vorgekommen, welcher im Folgenden beschrieben werden wird, theils um die Zahl der seltneren nach der Geburt auftretenden Fälle um einen zu vermehren, theils auch, weil dieser Fall dem Dohrn'schen sich näher anschliesst. Nehmen wir eine Urämie als Ursache an, so bleibt es dennoch unbegreiflich, wie ganz unbedeutende anatomische Veränderungen an den Nieren einer so schweren Erkrankung sollten zum Ursprunge dienen können.

Eie Eclampsie ist im Ganzen keine häufige Erkrankung. Die Frau Lachapelle

sah sie unter 38,000 Entbindungen nur 68 Mal auftreten, Braun unter 24,000 52 Mal; Anderen ist sie häufiger vorgekommen, so Velpau unter 2000 21 Mal. Nach der Statistik von Wieger ist sie 109 Mal vor Anfang der Wehen, 236 Mal während der Geburt und 110 Mal nach der Geburt aufgetreten.

F. L., eine kräftige und gesund aussehende Erstgebärende von 23 Jahren, wurde den 28. September Morgens 6 Uhr kreissend in die Anstalt aufgenommen. Sie war von grosser Statur und starkem Knochenbau, die Unterschenkel waren gerade, die Lendengegend nicht eingezogeu. Die Beckenmessung wurde versäumt, weil die Schwangere gleich auf das Geburtsbett gebracht worden war. Ueber ihre Kindheit gab sie an, dass sie stets gesund gewesen und nicht an der englischen Krankheit gelitten habe; wann sie gehen gelernt, war ihr jedoch nicht bekannt. Die Menstruation war zum ersten Male in ihrem 14. Jahre eingetreten, aber eine Zeit lang unregelmässig verlaufen, Jahre lang ausgeblieben. Der Blutabgang war im Ganzen nur gering, und niemals von Schmerzen begleitet.

Während ihrer Schwangerschaft hatte sie sich stets wohl befunden, nur in einem Zeitraum von vier Wochen eine Anschwellung der Unterschenkel bemerkt, welche allmählig wieder abnahm und nur noch in mässigem Grade bei ihrer Aufnahme in die Anstalt bestand. An anderen Körpertheilen, so unter den Augen war sie nicht geschwollen gewesen. Die Menses waren zuletzt nach ihrer etwas ungenauen Angabe zu Anfang oder in der Mitte des Decembers erschienen; die ersten Kindsbewegungen will sie den 16. Mai in der rechten oberen Bauchgegend gefühlt und eine Abnahme der Lebhaftigkeit derselben in den letzten Tagen vor ihrer Entbindurg beobachtet haben. Die Wehenthätigkeit hatte 2 Uhr Morgens begonnen, um 6 Uhr wurde die äusserliche Untersuchung auf dem Geburtsbette vorgenommen. Die Ausdehnung des Uterus war eine ziemlich gleichmässige, seine Wandung von Fruchtwasser mässig gespannt; derselbe war etwas nach rechts geneigt und überragte den Nabel eine Hand breit. Die Frucht lag in der ersten Diagonale, und der Foetalpuls war in der rechten Seite deutlich hörbar. Bei der inneren Untersuchung fühlte man den Kopf vorliegend, tiefstehend, das vordere Scheidengewölbe hervordrängend. Der Muttermund war nach hinten gerichtet, dem Finger durchgängig, ein kurzer Cervicalkanal noch vorhanden. Gegen 8 Uhr hatte der Muttermund sich über einen Zoll weit geöffnet. Die Blase war nicht zu fühlen und wahrscheinlich schon um diese Zeit gesprungen, obgleich ein Abfluss von Fruchtwasser nicht bemerkt worden war; der Uterus lag der Frucht enger an. Die Pfeilnaht verlief im queren Durchmesser des Beckens, die kleine Fontanelle war rechts, die grosse in der linken Seite fühlbar; das vordere Scheitelbein war etwas deprimirt, unter das hintere geschoben, die Kopfknochen bei Druck ziemlich nachgiebig. Die Wehen kehrten nach regelmässigen Pausen wieder, waren recht kräftig, fingen aber an schmerzhaft zu werden. Auch zeigte die Kreissende jetzt eine im Laufe des Vormittags zunehmende Schmerzhaftigkeit bei der Untersuchung und ein auf-

fallendes Zittern des Körpers während der Wehe mit Zähneklappern verbunden, ohne dass sie das Gefühl der Kälte hatte. Sie klagte nicht über Kopfschmerzen, nur sei der Kopf ihr so schwer; auch hatte sie keine abnormen Sinnesempfindungen. Uhr 11 war der Muttermund sehr nachgiebig, gut $1\frac{1}{2}''$ weit. Das Hinterhaupt war tiefer herabgedrückt in Folge der Lagerung auf die rechte Seite. Auf die ungewöhnliche Schmerzhaftigkeit der Kreissenden bei deren Untersuchung und das eigenthümliche Zittern aufmerksam gemacht, besuchte Prof. Litzmann $12\frac{1}{2}$ Uhr die Kreissende. Er fand den Puls auffallend langsam und voll. Es wurde die Temperatur gemessen, welche 37,4° in der Scheide betrug, und der Versuch gemacht, den Harn mittelst des Katheters behufs einer Untersuchung auf Eiweiss zu entleeren, da die Erscheinungen einen drohenden eclamptischen Anfall fürchten liessen. Von diesem Versuche musste man aber abstehen, weil bei der Berührung der Urethra mit dem Katheter die Empfindlichkeit sich so gross zeigte, dass die Kreissende zusammenfuhr und laut aufschrie. Um 2 Uhr war der Muttermund völlig erweitert, die Pfeilnaht stand im zweiten schrägen Durchmesser. Die Wehen hatten aber an Stärke und Wirksamkeit beträchtlich abgenommen, so dass in der Folge der Kopf nur unmerklich vorrückte. Gegen 3 Uhr stand der Kopf im geraden Durchmesser. Indess war aber die Kreissende sehr ungeduldig und erschöpft worden, klagte beständig über Schmerzen im Leibe und Kreuze, die Herztöne des Kindes waren nicht so laut wie vorhin zu hören, so dass endlich $\frac{1}{2}$ Stunde später beschlossen wurde, die Geburt mit der Zange zu beendigen. Mit vier bis fünf während der schwachen Wehen ausgeführten Tractionen wurde der Kopf entwickelt, worauf das Gesicht sich nach dem linken Schenkel der Mutter wandte; der Rumpf aber wurde durch die folgenden Wehen ohne Kunsthülfe ausgetrieben. Das Kind war sehr asphyktisch, schrie nicht, machte nur von Zeit zu Zeit angestrengte Athmungsbewegungen, das Herz pulsirte aber noch fort. Es ward rasch abgenabelt, in ein warmes Bad gethan, in welchem die Belebungsversuche fortgesetzt wurden, welche sich jedoch unnütz zeigten: Der Körper des Knaben war mager, die Haut weit und faltig. Sein Gewicht betrug 2776 Grmm., seine Länge 48 Centmts. Der gerade Durchmesser des Kopfes maass $3''$ $11'''$, der quere $3''$ $3'''$, der schrage $4''$ $4'''$, die Circumferenz 32 Centmtrs.

Die Nachgeburt wurde nach $\frac{1}{4}$ Stunde normal ausgestossen, der Uterus contrahirte sich gut; der Blutverlust war gering, bei der Extraction war ein kleiner Dammriss entstanden. Der nach der Entbindung gelassene Harn enthielt Eiweiss in geringer Menge. Die Wöchnerin befand sich von jetzt ab ganz wohl, nur klagte sie noch immer über Schmerzen im Kreuz; sie zeigte am Abende einigen Appetit und, nachdem sie zur Besänftigung der Schmerzen ein viertelgräniges Morphiumpulver erhalten, schlief sie, immer noch etwas unruhig, ein.

Da trat plötzlich 10 Uhr Abends, also 6 Stunden nach der Entbindung, der erste eclamptische Anfall ein. Die Wärterin, welche sich eben zur Ruhe begeben

hatte, eilte herbei und fand die Wöchnerin in gewaltigen Zuckungen liegen. Ein heftiges Erbrechen, durch welches die am Abend genossenen Speisen vollständig entleert zu sein schienen, war dem Anfall unmittelbar vorhergegangen; auch wurde der Eintritt einiger der folgenden Anfälle durch Würgen angezeigt.

Die ersten Zuckungen traten in dem Gesichte auf und ergriffen blitzschnell alle Gesichtsmuskeln: Die Augenlider öffneten und schlossen sich fast in demselben Moment, die Augenbrauen verzogen sich nach verschiedenen Richtungen, der Bulbus wurde aufwärts gerollt. Die Mundwinkel wurden bald gesenkt, bald gehoben, der durch die raschen Bewegungen der Kiefer und der zerbissenen Zunge zu blutigem Schaum gepeitschte Speichel trat vor den Mund. Die Pupillen waren erweitert und blieben starr und unbeweglich bei Lichtreiz. Der Kopf wurde hin und her geschleudert, oft auch durch den Krampf der Kopfnicker vornüber auf die Brust geneigt. In einem Augenblick breiteten sich nun die Convulsionen auch auf die oberen Extremitäten aus, welche von kurzen, aber kräftigen Stössen erschüttert, gebeugt und gestreckt wurden; dann trat die nämliche Erscheinung an den unteren Extremitäten auf und zuletzt waren beide in heftigen, schüttelnden Bewegungen begriffen. Zwei bis drei kräftige, deutlich abgegränzte Stösse beider oberen und unteren Extremitäten, ähnlich den von einem starken elektrischen Strom erzeugten, beschlossen in der Regel den Anfall. Alle Anfälle hatten diesen den epileptischen Convulsionen eigenthümlichen Typus. Nach jedem Anfalle trat ein komatöser Zustand ein mit stertorösem Athem; nur in dem Zwischenraum der ersten 3 bis 4 Anfälle hörte das Coma auf und das Bewusstsein kehrte wieder, so dass die Kranke auf Fragen antwortete und über Schmerzen im Kreuz und Leibe klagte, zwischen den folgenden aber dauerte das Coma ununterbrochen fort und das Bewusstsein kehrte nicht zurück. Doch bemerkte man zu der Zeit, wo man das Ende des comatösen Zustandes erwarten konnte, dass die Kranke sich häufig umherwarf, den Arm mit Gewalt wegzog, wenn man ihn erfasste, ab und zu stöhnte und den Kopf gegen die Wand kehrte, wenn man ein Glas an ihre Lippen brachte. Bei dem zweiten Anfall wurde dafür gesorgt, dass ein umwickelter Löffelstiel zur Verhütung einer weiteren Verwundung der Zunge zwischen die Zähne geschoben wurde. Es war nun interessant zu sehen, wie vor den nächsten Anfällen, wenn die Zuckungen schon im Gesicht spielten, die Augäpfel sich nach oben wälzten, die Kranke sich anstrengte, den Mund, welcher sich durch den beginnenden Krampf zu einem Viereck verzog, zu öffnen und so lange offen zu halten, bis der wohlthätige Löffel sich zwischen den Zähnen befand, worauf dann sogleich die gewaltigen Erschütterungen des Körpers anfingen. Während jedes Anfalles und kurze Zeit nach demselben erreichte die Pulsfrequenz eine beträchtliche Höhe, nahm dann allmählig wieder ab, bis zu 48 Schlägen in der Minute, um kurz vor dem nächsten Anfall wieder zu steigen, so dass derselbe sich hieraus schon vorhersagen liess. Nach dem 2. Anfall wurde eine Injection von $\frac{1}{4}$ Gr. Morphium gemacht, welche nach dem

5. wiederholt wurde, ohne den Zustand im Geringsten zu bessern. Später wurden sechs Blutegel an die Schläfe applicirt, Eis auf den Kopf gelegt und noch eine Injection von $\frac{1}{6}$ Gr. Morph. gemacht. In dem Zeitraum von 10 Uhr Abends bis $3\frac{1}{2}$ Uhr Morgens, wo der Tod erfolgte, war die Zahl der Anfälle auf 16 gestiegen. Zwischen den ersten 11 Anfällen, welche bis Uhr 2 notirt wurden, war eine Pause von $\frac{1}{2}$—$\frac{1}{4}$ Stunde, die anderen folgten in kürzeren Zwischenräumen von 10 Minuten und waren heftiger als die ersten. (Siehe das untenstehende Verzeichniss der Reihenfolge der Anfälle.) Das Gesicht der Kranken war in einer Reihe von Anfällen blass, während der letzten aber wurde es cyanotisch; der Puls war in dem vorletzten Anfall verschwindend klein und kehrte erst bei beginnender Respiration wieder. Nachdem der 16. Anfall zu Ende war, verschied die Kranke nach wenigen Athemzügen;

Anfälle	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Uhr	10	$10\frac{1}{2}$	$11\frac{1}{4}$	$11\frac{1}{2}$	12	$12\frac{1}{2}$	$12\frac{3}{4}$	1	$1\frac{1}{2}$	$1\frac{3}{4}$	2	2.10′	2.20′	$2\frac{1}{2}$	2.55′	3.25′

Der vor dem Ausbruch der Eclampsie entleerte Harn enthielt an Eiweiss 0,054 %; in demselben fanden sich keine Fibrincylinder. Der procentische Gehalt desselben an Harnstoff betrug 1,4 und das specifische Gewicht war 1013. Bei der Section wurde eine Portion Harn aus der Blase gewonnen, welcher ein specifisches Gewicht von 1015 zeigte, an Eiweiss 0,234 % und an Harnstoff 1,65 % enthielt. Auch wurden 205 Grmm. Blut aus der Leiche aufgefangen, in welchen bei der chemischen Untersuchung 0,24 Grmm. Harnstoff, also 0,117 % gefunden wurden.

Sectionsbefund.

Wohlgenährte, kräftige Leiche, starker panniculus adiposus, an den unteren Extremitäten leichtes Oedem, starker rigor mortis. An dem Rücken und an den Extremitäten Imbitionsröthe. Die linke Lunge in ihrem hinteren Umfange und an der Basis mit dem parietalen Blatt der Pleura flächenhaft und fest verwachsen; die rechte überall beweglich. An den Rändern der Zunge frische Sugillationen und eine deutliche alte Narbe von 2‴ Länge. — Schleimhaut des Kehlkopfs geröthet, die grossen Bronchien sind von blossem Schleim erfüllt, und von hier an beginnt eine starke Injection der Schleimhaut. Diese Verhältnisse sind an beiden Lungen gleich. Die Substanz der Lunge lufthaltig; bloss im unteren Lappen der linken Lunge, gegenüber der vorher erwähnten Anheftung und einer tieferen Einfurchung, findet sich ein ganz festes, kreidiges Concrement von unregelmässiger Gestalt und eine halbe Nuss gross. Im Uebrigen zeigt sich die Substanz der Lunge normal. Das Herz in seinem linken Theil fest zusammengezogen, im Herzbeutel röthlich gefärbtes Serum; die

Klappen normal. Die Bicuspidalklappe am Rande knotig verdickt, übrigens normal; ebenso die Semilunarklappen der Aorta. — Die glandula thyreoidea in ihren seitlichen Lappen zu einer ansehnlichen Kropfgeschwulst ausgedehnt; im linken Lappen ein wallnussgrosser Bluterguss, im rechten ein haselnussgrosses, steinhartes Concrement. — Milz von natürlicher Grösse, blutreich. — Leber gross, an der convexen Oberfläche des rechten Lappens ein bedeutendes Extravasat; unter demselben dringt noch eine starke Gefässinjection mehr als Zoll weit in die Tiefe. Oberhalb des Lig. coronar. ist der Peritonäalüberzug eine Strecke weit durch freien Bluterguss vom Leberparenchym abgehoben; ähnliche Blutergüsse des Peritonäalüberzuges des Organes finden sich an der unteren Fläche. — Uterus von zwei Faust Grösse, fest zusammengezogen. Innenfläche mit einem dünnen schwarzen Blutcoagulum bedeckt, im Uebrigen die Höhle leer. Das Coagulum haftet in der Gegend des Fundus und mehr an der vorderen Fläche. — Linke Niere etwas unregelmässig gestaltet, wie gelappt; Kapsel leicht abziehbar, etwas kleiner als in der Norm, stark geröthet, zeigt aber auf der Schnittfläche nicht die geringste Abnormität; ihre Consistenz ist derb und fest. — Rechte Niere von derselben Grösse wie die linke und in allen Stücken von derselben Beschaffenheit wie diese. — Der Schädel an der Innenfläche stark geröthet, und namentlich am Scheitelbein deutliche Knochenauflagerungen. Nach Entfernung der Dura mater findet sich auf beiden Hemisphären, besonders auf der rechten, ein geronnenes Blutextravasat; auf der rechten von dem Umfang eines Zweithalerstücks. — Nach Entfernung des Gehirns bleibt etwa eine Unze klares Serum auf der Schädelbasis liegen. Das obengenannte Extravasat befindet sich unter der Arachnoidea, hat jedoch die Maschen der pia mater blutig infiltrirt. Die Gehirnsubstanz selbst hat sich an den Veränderungen nicht betheiligt, bis auf eine Windung, welche auf der Scheitelhöhe neben dem Falx cerebri liegt. Hier finden sich in der Hirnsubstanz selbst eine Anzahl linsengrosse Blutflecken, welche in die Substanz selber eindringen. Aehnliche Veränderungen finden sich in dem sulcus, welcher die genannte Windung von den benachbarten trennt, und an der der Falx cerebri zugekehrten Wand der Hemisphäre. Noch tiefer dringt diese Veränderung unter dem kleinen Extravasat auf der linken Grosshirnhemisphäre und auf dem vorderen Lappen in die Substanz des Hirns ein, so dass dieselbe hie und da im Umfang von Hanfkorngrösse zertrümmert ist. Im rechten Seitenventrikel befindet sich ein Erguss von blutigem Serum in geringer Menge; der Inhalt des linken Seitenventrikels ist klar. Das Adergeflecht des rechten Seitenventrikels ist an einer kleinen Stelle blutig infiltrirt. Der dritte Ventrikel von natürlichem Umfang. Am 4. Ventrikel nichts Abnormes. Die grossen Ganglien an der Hirnbasis, die Medulla oblongata, die Crura magna cerebri bieten nichts abweichendes dar.

Die mikroskopische Untersuchung der in Alkohol aufbewahrten und erhärteten Nieren ergab: Die gewundenen Harnkanälchen der Rinde zeigten eine schwache,

bräunliche Blutfarbstoffimbibition ihrer Epithelien, die aber sonst normal waren. Die Epithelien der offenen Harnkanälchen waren, frei von Farbstoff, normal, weder von einer Fettdegeneration noch von Cylindern in keiner Region beider Nieren etwas nachweisbar. — Es wird ein hyperämischer Zustand der Nierenrinde bei Lebzeiten bestanden haben, jedenfalls aber keine parenchymatöse oder interstitielle Veränderung.

Der oben beschriebene Fall von Eclampsie schliesst sich den nach Brummerstädt's statistischen Untersuchungen sich stets mehrenden Fällen an, in welchen eine urämische Intoxication als Ursache nicht anzunehmen sei. (Siehe „Jahresbericht üb. d. Leistung. u. Fortschr. in d. ges. Medic. (Forts. d. Canstatt'schen Jahresberichts)" Band II. pag. 529.) Er hat im Ganzen 135 Fälle von Eclampsie zusammengestellt; in 51 erfolgte der Tod, in 106 enthielt der Urin Eiweiss.

In dem von mir mitgetheilten Falle zeigten die Nieren bei der Section durchaus unerhebliche Veränderungen, so dass dieselben wohl nicht die Ursache der Eclampsie gewesen sein können. Auch war eine Vermehrung der Extractivstoffe im Blute, wie bei der Urämie, nicht nachzuweisen. Die Kranke war während ihrer Schwangerschaft stets gesund gewesen. Das kurze Zeit bestandene Oedem der unteren Extremitäten ist mehr eine Folge ihrer Beschäftigung gewesen, als das Symptom eines Nierenleidens, zumal da die Nieren bei der Section so gut wie gesund gefunden wurden. Andererseits lässt sich dieser Fall von Eclampsie nicht mit einer solchen Bestimmtheit wie der von Dohrn mitgetheilte als von einer urämischen Intoxiation unabhängig hinstellen, weil der stricte Nachweis einer genügenden Harnstoffausscheidung durch den Harn wegen Mangel an Material nicht geliefert werden konnte: die Harnstoffmenge konnte nur procentisch bestimmt werden. — In diesem Falle war vor der Eclampsie Eiweiss im Harn enthalten. Ob aber schon während der Schwangerschaft längere Zeit Albuminurie bestanden hat, war ebenfalls nicht möglich zu entscheiden, weil die Kranke kreissend aufgenommen wurde. Jede Albuminurie der Schwangeren aber bedingt noch keine Urämie und Eclampsie. In den Nieren aber fand sich keine Spur von parenchymatöser Entzündung oder Degeneration.

THESEN.

I. Die Venäsection ist bei der Behandlung der Pneumonie nur anzuwenden, wenn Erstickungsgefahr droht.

II. Die Hand ist das beste Mittel zur Reposition der Nabelschnur.

III. Die Iridectomie ist das sicherste Mittel gegen das Glaucom.

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With A. Liversidge's compliments.

THE UNIVERSITY,
SYDNEY.

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THE MINERALS OF NEW SOUTH WALES.

BY

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SECOND EDITION.

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THE MINERALS OF NEW SOUTH WALES.

BY

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THE following paper was originally read before the Royal Society of New South Wales in December, 1874, and appeared in the Society's Transactions for that year. Since that time every opportunity open to me has been taken advantage of to correct and add to it; special attention has been paid to the chemical composition of the minerals; but on account of the great length of time required to make complete analyses and the difficulty of obtaining specimens sufficiently pure for the purpose the number of minerals analysed is by no means equal to my wishes.

In addition to my own I have incorporated the analyses of minerals made by others, and notably those made by Mr. W. A. Dixon, F.I.C., for the Mining Department, and published in the annual reports of the Department of Mines, Sydney.

I may, perhaps, state that the descriptions of the minerals are given almost entirely from specimens which I have either collected myself or which have come under my own personal observation. It is much to be regretted that no systematic examination of the minerals and rocks of New South Wales has been undertaken similar to that performed in other Colonies. The amount of exact information upon the chemical composition of the various minerals occurring in New South Wales which has yet been published is extremely small, and by no means equal to what might naturally be expected from a Colony so rich and prosperous, and so well endowed with mineral wealth.

Great difficulty was at times found in identifying certain of the localities, from the changes which the names of places have in many cases undergone—numbers of localities I have had to reject altogether on this account, and some uncertain ones probably still remain; but as it is still my intention, as stated in the original edition, to bring this introductory paper out in a more complete form, with, if possible, descriptive figures of the more remarkable specimens, I hope to be able to correct any mistakes which may have crept in, and in a paper of this kind it is almost impossible that some should not occur, although I have done my best to keep the number down to as few as possible. Too often it is the practice to intentionally mislead, especially if the collector fancies that the mineral is likely to be of commercial value; this is of course done with the object of preventing the information leaking out in any way, and the finder being forestalled in making application for a mineral lease or the right to work the deposit.

Some of the localities have been taken from papers published by the late Rev. W. B. Clarke, M.A., F.R.S., the late Mr. Stutchbury, who was for some time Government Geologist, from some of the reports of the earlier explorers, and from the publications of the Mining Department.

PART I.

METALLIC MINERALS.

Gold.

Only one true mineral species of gold has up to the present been found in New South Wales, and that is—

Native Gold.

Crystallizes in the cubical system. Well developed crystals are very rare and are never of large size, seldom exceeding $\frac{1}{4}$ inch in diameter, and the faces are usually more or less cavernous; the most common form are the octohedron and rhombic dodekahedron; single and detached crystals are seldom found—they are usually attached end to end, forming strings, wires, and branching or arborescent forms. A beautiful branching tree-like group of large rhombic dodekahedral crystals weighing some 20 ozs. was formerly to be seen in the Australian Museum collection, but the specimen has been stolen, so that it is unfortunately lost to science, for no goniometrical measurements were made, and not even a cast or drawing seems to have been retained. Occasionally elongated crystals of rhombic dodekahedra are met with, arranged in columnar masses very similar to groups of basaltic columns. Some very perfect crystals were obtained in the early days of gold-mining from the Louisa Creek. As with other minerals, the smaller crystals are usually the most perfect. Filiform, reticulated, and spongy shapes are common; but more so are irregular plates, scales, and strings, which interpenetrate the matrix in every direction. In one or two specimens from the "Uncle Tom Mine," Lucknow, I have observed capillary crystals or filaments of gold resembling the artificial "moss gold," or the better known "moss copper"; in this mine the gold occurs with mispickel and calcite, the matted or moss-like filaments being met with in small cavities in the former mineral.* Sometimes, as observed by Mr. C. S. Wilkinson at the Cowarbee Mine, about 40 miles north-west of Wagga Wagga, the plates are so exceedingly thin that they form mere films like gold-leaf, and in this particular instance the films run both between and across the laminæ of the red-coloured schistose rock in which they occur. Then, again, gold occurs in New South Wales, as elsewhere, so finely divided and equally diffused throughout the matrix as to be invisible even by the aid of a lens.

As alluvial gold it occurs in more or less rounded and water-worn flattened grains, scales, and pebbles or nuggets. The largest nuggets discovered in Australia have been found in Victoria; none at all to compare with them in size have been in New South Wales.

Examples of New South Wales Nuggets.

No. 1. Found in July, 1851, by a native boy, amongst a heap of quartz, at Meroo Creek or Louisa Creek, River Turon, 53 miles from Bathurst, and 29 miles from Mudgee, New South Wales, where there is now a township known as Hargraves. It was in three pieces when discovered, though generally considered as one mass. The aboriginal who discovered these blocks "observed a speck of some glittering substance upon the surface of a block of the quartz, upon which he applied his tomahawk, and broke off a portion." One of the pieces weighed 70 lbs. avoir., and gave 60 lbs. troy of gold; the gross weight of the other two about 60 lbs. each. These three pieces, weighing $1\frac{3}{4}$ cwt., contained 106 lbs. troy of gold, and about 1 cwt. of quartz. In the same year another nugget, weight 30 lbs. 6 ozs., was discovered in clay, 24 yards from the large pieces; and in the following year, near to No. 6, there were found two nuggets, weighing 157 ozs. and 71 ozs.

Gross weight (troy), 106 lbs., or 1,272 ozs.

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* On the formation of moss gold and silver (A. Liversidge, *Trans. Roy. Soc. of N. S. W.*, 1876).

The following account of the discovery of the above "hundredweight of gold," as it was termed, is quoted in Stirling's "Gold Discoveries of 1862," from the *Sydney Morning Herald*, of 18th July, 1851 :—

"Bathurst is mad again. The delirium of golden fever has returned with increased intensity. Men meet together, stare stupidly at each other, talk incoherent nonsense, and wonder what will happen next. Everybody has a hundred times seen a hundredweight of flour; a hundredweight of sugar or potatoes is an every-day fact; but a hundredweight of gold is a phrase scarcely known in the English language. It is beyond the range of our ordinary ideas—a sort of physical incomprehensibility; but that it is a material existence our own eyes bore witness on Monday last.

"Mr. Suttor, a few days previously threw out a few misty hints about the possibility of a single individual digging four thousand pounds' worth of gold in one day, but no one believed him serious. It was thought that he was doing a little harmless puffing for his own district, and the Turon Diggings. On Sunday it began to be whispered about town that Dr. Kerr (Mr. Suttor's brother-in-law), had found a hundredweight of gold. Some few believed it; but the townspeople generally, and amongst the rest the writer of this article, treated the story as a piece of ridiculous exaggeration and the bearer of it as a jester, who gave the Bathurstonians unlimited credit for gullibility. The following day, however, set the matter at rest. About 2 o'clock in the afternoon, two greys, in tandem, driven by W. H. Suttor, Esq., M.C., made their appearance at the bottom of William-street. In a few seconds they were pulled up opposite the *Free Press* office, and the first indication of the astounding fact which met the view, was two massive pieces of the precious metal, glittering in virgin purity as they leaped from the solid rock. An intimation that the valuable prize was to reach the town on that day having been pretty generally circulated in the early part of the morning, the townspeople were on the *qui vive*, and in almost as little time as it has taken to write it, 150 people had collected around the gig conveying the time's wonder, eager to catch a glimpse of the monster lump said to form a portion of it. The two pieces spoken of were freely handled about amongst the assembled throng for some twenty minutes. Astonishment, wonder, incredulity, admiration, and the other kindred sentiments of the human heart were depicted upon the features of all present in a most remarkable manner, and they were by no means diminished in intensity when a square tin box in the body of the vehicle was pointed to, as the repository of the remainder of the hundredweight of gold. Having, good-naturedly, gratified the curiosity of the people, Mr. Suttor invited us to accompany his party to the Union Bank of Australia to witness the interesting process of weighing. We complied with alacrity, and the next moment the greys dashed off at a gallant pace, followed by a hearty cheer from the multitude.

"In a few moments the tin box and its contents were placed on the table of the boardroom of the bank. In the presence of the manager, David Kennedy, W. H. Suttor, I. J. Hawkins, Esqs., and the fortunate proprietor (Dr. Kerr), the weighing commenced, Dr. Machattie officiating, and Mr. Ferrand acting as clerk. The first two pieces already alluded to weighed severally 6 lbs. 4 ozs. 1 dwt. and 6 lbs. 13 dwts., besides which were sixteen drafts of 5 lbs. 4 ozs. each, making in all 102 lbs. 9 ozs. 5 dwts. From Dr. Kerr we learned that he had retained upwards of 3 lbs. as specimens, so that the total weight found would be 106 lbs. (one hundred and six pounds), all disembowelled from the earth at one time. And now for the particulars of this extraordinary gathering, which has set the town and district in a whirl of excitement.

"A few days ago an educated aboriginal, formerly attached to the Wellington Mission, and who had been in the service of W. J. Kerr, Esq., of Wallawa, about seven years, returned home to his employer with the intelligence that he had discovered a large mass of gold amongst a heap of quartz upon the run whilst tending his sheep. Gold being the universal topic of conversation, the curiosity of this sable son of the forest was excited, and, provided with a tomahawk, he had amused himself by exploring the country adjacent to his employer's land, and had thus made the discovery. His attention was first called to the lucky spot by observing a speck of some glittering yellow substance upon the surface of a block of quartz, upon which he applied his tomahawk and broke off a portion—at that moment the splendid prize stood revealed to his sight. His first care was to start off home and disclose his discovery to his master, to whom he presented whatever gold might be procured from it. As might be supposed, little

time was lost by the worthy doctor. Quick as horseflesh would carry him, he was on the ground, and in a very short period the three blocks of quartz, containing the hundredweight of gold, were released from the bed, where, charged with unknown wealth, they had rested perhaps for thousands of years, awaiting the hand of civilised man to disturb them. The largest of the blocks was about a foot in diameter, and weighed 75 lbs. gross. Out of this piece 60 lbs. of pure gold was taken. Before separation it was beautifully encased in quartz. The other two were something smaller. The auriferous mass weighed as nearly as could be guessed from 2 to 3 cwt. Not being able to move it conveniently, Dr. Kerr broke the pieces into small fragments, and herein committed a very grand error—as specimens the glittering blocks would have been invaluable. Nothing yet known of would have borne comparison, or, if any, the comparison would have been in our favour. From the description given by him, as seen in their original state, the world has seen nothing like them yet.

"The heaviest of the two large pieces presented an appearance not unlike a honeycomb or sponge, and consisted of particles of a crystalline form, as did nearly the whole of the gold. The second larger piece was smoother, and the particles more condensed, and seemed as if it had been acted upon by water. The remainder was broken into lumps of from 2 to 3 pounds and downwards, and were remarkably free from quartz or earthy matter; when heaped together on the table they presented a splendid appearance, and shone with an effulgence calculated to dazzle the brain of any man not armed with the coldness of stoicism.

"The spot where this mass of treasure was found will be celebrated in the golden annals of these districts, and we shall therefore describe it as minutely as our means of information will allow. In the first place, the quartz blocks formed an isolated heap, and were distant about 100 yards from a quartz vein, which stretches up the ridge from the Murroo Creek. The locality is the commencement of an undulating tableland, very fertile, and is contiguous to a never-failing supply of water in the above-named creek. It is distant about 53 miles from Bathurst, 18 from Mudgee, 30 from Wellington, and 18 from the nearest point of the Macquarie River, and is within about 8 miles of Dr. Kerr's head station. The neighbouring country has been pretty well explored since the discovery, but, with the exception of dust, no further indications have been found.

"These particulars were kindly furnished by Mr. Suttor and Dr. Kerr, and may therefore be relied on as correct."

No. 2. A model of what is said to be the first large nugget found in New South Wales is to be seen in the Australian Museum, Sydney. Found in Ophir Creek.

Several other large nuggets appear to have been found in this creek, but none of them approaching to the above in size and value.

No. 3. A nugget weighing 26 ozs. was found at Bingera in 1852.

No. 4. Found by a party of four, on 1st November, 1858, at Burrandong, near Orange, New South Wales, at a depth of 35 feet; when pounded with a hammer it yielded 120 lbs. of gold, for which £5,000 were offered. Melted at the Sydney Mint, when it weighed 1,286 ozs. 8 dwts.; after melting, 1,182 ozs. 7 dwts.; loss, 8 per cent.; fineness, 87·4 per cent.; the standard weight of gold being 1,127 ozs. 6 dwts. Value, £4,389 8s. 10d. The gold was mixed with quartz and sulphide of iron (mundic). Assay, 87·40 per cent gold = 20 car. $3\frac{7}{8}$ car. grs.

Gross weight (troy), 107 lbs. 2 ozs. 8 dwts.; or 1,286 ozs. 8 dwts.

No. 5. Found at Kiandra, Snowy River, New South Wales, October, 1860.

Gross weight (troy), 33 lbs. 4 ozs.; or 400 ozs.

No. 6. "The Brenan Nugget." Found in Meroo Creek, Turon River, New South Wales, embedded in clay; measures 21 inches in circumference. It was found 24 yards from No. 1. Sold in Sydney, 1851, for £1,156.

Gross weight (troy), 30 lbs. 6 ozs.; or 364 ozs. 11 dwts.

No. 7. Found at New Chum Hill, Kiandra, Snowy River, New South Wales, July, 1861.

Gross weight (troy), 16 lbs. 8 ozs.; or 200 ozs.

No. 8. Found at Kiandra, Snowy River, New South Wales, March, 1860.

Gross weight (troy), 13 lbs. 4 ozs.; or 160 ozs.

No. 9. Found, in 1852, at Meroo Creek, Turon River, New South Wales, close to No. 1. This was called "The King of the Waterworn Nuggets."

Gross weight (troy), 13 lbs. 1 oz.; or 157 ozs.

No. 10. Found in 1860, at the Tooloom Diggings, New South Wales; nearly solid gold. Gross weight (troy), 11 lbs. 8 ozs.; or 140 ozs.

No. 11. Found at Kiandra, Snowy River, New South Wales, March, 1860. Gross weight (troy), 7 lbs. 9 ozs. 18 dwts.; or 93 ozs. 18 dwts.

No. 12. Found in 1852, at Louisa Creek, New South Wales; a solid lump of gold. Gross weight (troy), 6 lbs. 10 ozs.; or 82 ozs.

No. 13. Found by two boys, in July, 1861, at Gundagai (new diggings), New South Wales. Gross weight (troy), 5 lbs. 4 ozs. 7 dwts.; or 64 ozs. 7 dwts.

No. 14. Found in 1857, at Louisa Creek, New South Wales; gold and crystallized quartz. Gross weight (troy), 4 lbs. 2 ozs.; or 50 ozs.

No. 15. Found at New Chum Hill, Kiandra, New South Wales, in July, 1861. Gross weight (troy), 3 lbs. 6 ozs.; or 42 ozs.

No. 16. Found at Summer Hill Creek, New South Wales. The earliest nugget found in New South Wales after the gold discovery there by Hargraves. 13th May, 1851. Gross weight (troy), 1 lb. 1 oz.; or 13 ozs.

No. 17. A nugget weighing 22 ozs. 18 dwts. 12 grs. was found recently on "M'Guiggan's Lead," about 9 miles from Parkes; the metal was of dark colour and free from gangue.

Nos. 18 to 23. During the year 1874 "M'Guiggan's Lead," the Terrace, Lachlan Division, is reported to have produced a nugget of 134 ozs., and other smaller ones of 7 ozs., 25 ozs., 35 ozs., 37 ozs.; and in 1876 one of 36 ozs.

Nos. 24 to 26. A nugget weighing 19 ozs. 12 dwts. was found early in 1876 at the "Wapping Butcher Mine," the Terrace, near Parkes; also others of 16 ozs. 10 dwts. and 18 ozs., together with a large number of smaller nuggets.

No. 27 and 28. A nugget of 43 ozs., together with one of 23 ozs., was discovered on the Nundle Gold-field in 1879.

No. 29. One of 32 ozs. 15 dwts. was found in October, 1879, in Broad Gully, in the Braidwood district, together with several smaller ones in the same year.

No. 30. One weighing 64 ozs. 3 dwts. was unearthed in the Canadian Lead, near Gulgong, November, 1876, at a depth of 140 feet; it was stated to have been so completely invested with a coating of iron oxide as to be superficially unrecognisable as gold.

No. 31. In 1874 a nugget of 65 ozs. was found on Woods' Flat, about 12 miles from Cowra.

No. 32. At the same place, and in the same year, another of 50 ozs. is reported.

No. 33. A nugget weighing 28 lbs. was found on the Whipstick Flat, Kiandra; recorded by Mr. Lamont Young, F.G.S., in the *Annual Report of the Mines Department for 1880*, but no date is given.

Nos. 34 to 45. At Temora the following were found during 1880:—99 ozs., 84 ozs., 76 ozs., 72 ozs., 68 ozs., 64 ozs., 63 ozs., and one of 59 ozs. 1 dwt.—this measured 7 inches by $2\frac{1}{4}$ inches wide, with thickness of about 1 inch, and described as not waterworn, but jagged, and with a half turn or twist in it; during the same year others of 46 ozs. 18 dwts. 20 grs., 40 ozs., 28 ozs., 24 ozs., 16 ozs., and 14 ozs. were met with.

No. 46. On March 16th, 1882, a nugget was found at Temora, weighing 153 ozs. 17 dwts., at a depth of about 14 feet.

No. 47. At Nerrigundah, at the foot of Mount Dromedary, a small one of 13 ozs. 15 dwts. was found in 1880.

For the accounts of No. 1 and Nos. 4 to 16 I am indebted to Mr. Brough Smyth's *Gold-fields and Mineral Districts of Victoria*.

In colour most of the New South Wales gold is usually of fairly deep yellow, being rather lighter than Victorian and not so light as much of the Southern Queensland gold, but occasionally specimens of very pale and of very dark gold are met with. The quantity of silver present greatly affects the colour of the metal.

In specific gravity it varies considerably, the mean being about 17·5.

A specimen of Braidwood gold had a specific gravity of 18·28.

Composition.—No specimens of actually pure gold have been met with. There is always more or less silver present, and usually traces of copper, bismuth, iron, and other metals.

Gold from the Pilot Reef, New Meragle Creek, Tumberumbah, yielded ·9689 fine gold.

ASSAYS, made at the Sydney Branch of the Royal Mint, of 48 specimens of New South Wales Gold, from the Collection exhibited in the Australian Museum prior to transmission to the Paris Exhibition.—December, 1854.

Locality.	Pure Gold in 1,000 parts.	Silver.	Copper and Iron.	External Character of Specimens.
WESTERN DISTRICT.				
TAMBAROORA. Dirt Hole Creek	945·90			Dull gold, in rounded grains like coarse sand.
" Dirt Hole Road Creek	952·45			Light and brilliant, small grain gold, with small nuggets.
"	950·10			
" Hayes' Flat	942·65			Bright nuggety gold, presenting very irregular shapes; little waterworn.
" Golden Gully	947·00			
" Bald Hill's Creek	946·00			
" Oaky Creek	944·55			Larger waterworn nuggets, dull in colour.
" Lower Turon	946·10	47·35 to 76·4	Trace to 12·5	Bright scaly gold, of uniform character.
" Macquarie River	947·30			Bright gold, consisting of small elongated and flattened pieces, with irregular nuggets.
" Upper Pyramul	922·85			Small nuggets or grains, moderately waterworn and dark coloured.
" Lower Pyramul	948·75			Brilliant, light, scaly gold.
" Junction of Pyramul and Macquarie	945·10			
"	944·55			Dull scaly gold, with small rounded nuggets.
"	946·45			Rough-grained gold.
TURON RIVER (SOFALA). Erskine Flat	923·80			Dull scaly gold, of uniform character.
" Green Wattle Flat	916·05			Nuggety gold, showing marks of crystallization; moderately waterworn.
" Little Oaky Creek	926·10			Rough-grained gold.
" Big Oaky Creek	931·60	42·9 to 83·7	" 1·3	Small rounded nuggets of dull colour.
" Nuggety Gully	956·40			Small nuggets, moderately waterworn.
" Golden Point	929·50			Scaly dull-coloured gold.
" Paterson's Point, E 1	925·60			Fine scaly gold, of uniform character, not bright.
" " E 2	923·05			Scales and rounded nuggets.
MEROO RIVER (AVISFORD). Devil's Hole Creek	957·95			Bright scaly gold, with waterworn nuggets.
" Nuggety Gully	961·40			Small waterworn nuggets, light and bright.
" Richardson's Point	958·45	38·6 to 50·05	" 1·05	Light and brilliant small scales.
" Gifford's Point	949·65			
" Deep Crossing Place	952·15			Ditto with large scales.
BURRENDONG. Long Point (Macquarie, below junction of Ophir Creek).	934·85	......	....	Dark-coloured scaly gold.
" Devil's Hole Creek. "Dry Diggings" ..	917·90	......	....	Nuggety gold, with marks of crystallization.
" Mookerawa Creek	942·80	56·9	" 0·3	Dull, dirty scales, and waterworn nuggets.
OPHIR CREEK	940·60	59·3	Other metals 0·1	Nuggety gold, much waterworn.
BROWN'S CREEK. 22 miles south of Bathurst	932·35	....	....	Dark, rough grains, mixed with blackish impurities
SOUTH-WESTERN DISTRICT.				
ADELONG CREEK. 5 miles below source	936·85			Rough nuggety gold.
" 8 miles below source	946·45			Nuggety; smaller, and more waterworn than last.
" 11 miles from source	945·20	51·15 to 66·65	" 0·15 to 1·3	
" 25 miles from source	948·60			Fine granular gold, light in colour.
"	932·00			Fine, bright, scaly gold.
SOUTHERN DISTRICT.				
ARALUEN. Major's Creek, Southern Arm	935·10			Bright granular gold.
" Bell's Paddock	895·90	50·5 to 103·45	....	Dull granular, with rough nuggets.
" Major's Creek, Western Arm	949·20			Dark-coloured, rounded grains, larger than last.
" In broken granite, 10 feet below surface	915·05			Bright granular gold.
NORTHERN DISTRICT.				
HANGING ROCK (NUNDLE). Oakanville Creek	936·80			Rough nuggety gold.
" Same Creek, 3 miles farther down	937·60			Rough scaly gold.
" Cordillera Gold Co.'s property on the River Peel.	906·65	62·95 to 93·25	....	Small dark-coloured nuggets, moderately waterworn.
" Gully leading to the Peel, north of Oakanville Creek.	930·15			
BINGARA. Nugget weighing 4 oz. 3 dwt.	874·25	125·25	....	A porous, spongy kind of nugget, containing dusty impurities in the pores.
"	894·45			Small rounded grains and nuggets of brightish colour.
ROCKY RIVER	943·70	56·3	....	Very small granular gold, light and brilliant.

The average value of the above was found to be 80s. 6d. per oz., the value of standard gold being 77s. 10½d. per

TABLE showing the proportion of gold and silver in characteristic samples of gold dust from various localities in New South Wales, after melting. By F. B. Miller, F.C.S., late Assayer in the Sydney Branch of the Royal Mint.

Locality.	Gold in 1,000 parts.	Silver in 1,000 parts.
NORTHERN.		
Boonoo Boonoo	854 to 659	337 to 298
Fairfield	872	121
Timbarra	708 to 898	280 to 97
Peel River	929	67
Rocky River	934 to 962	61 to 33
Nundle	923 to 937	66 to 63
WESTERN.		
Bathurst	827 to 903	164 to 92
Sofala	929 to 933	66 to 63
Tuena	943	54
Ophir	915	82
Tambaroora	943 to 954	54 to 42
Turon	918 to 928	78 to 68
Hargraves	915	83
Windeyer	946 to 959	53 to 37
SOUTHERN.		
Burrangong	948	48
Adelong	946 to 951	52 to 45
Braidwood	928 to 934	67 to 62
Emu Creek	971	27
Delegate	971	27
Nerrigundah	983	15

SAMPLES of GOLD characteristic of the Gold-fields of New South Wales exhibited by the Mining Department, and assayed at the Royal Mint, Sydney. From the New South Wales Official Catalogue, Philadelphia Exhibition, 1876.

Locality.	Description of Gold.	Weight of Sample.	Loss in melting per cent.	Gold and Silver in 1,000 parts after melting.		Value per oz., after melting, at £3 17s. 10½d., Standard.
				Gold.	Silver.	
WESTERN DISTRICT.		Ozs.				£ s. d.
Sofala	In fine scales, and coarse plates and grains	2·50	1·54	923·0	72	3 18 9½
Bathurst	Fine scales and coarse grains, with some spongy and stringy.	2·00	2·00	923·5	71	3 18 10
,,	Fine scales, plates, and coarse grains	2·00	1·47	918·0	76	3 18 4½
Hargraves	Fine dust and coarse grains	2·00	1·23	920·5	70	3 18 6½
,,	Scaly, with some grains	2·00	1·15	961·0	33	4 1 9½
Tambaroora	Fine and coarse scaly and grains	2·00	1·31	940·0	54	4 0 1
,,	Fine scales and grains	2·00	1·55	943·5	50	4 0 5
,,	Reef gold—reticulated	2·00	2·77	944·5	51	4 0 6
,,	Coarse waterworn grains or nuggets	2·00	2·00	935·5	54	3 19 8½
Hill End	Fine dust and coarse grains	2·00	2·47	945·5	47	4 0 7
,,	Scaly, with coarse spongy grains	2·53	1·41	945·5	50	4 0 7
,,	Fine scales and coarse crystalline gold	2·00	2·18	947·0	47	4 0 8½
,,	Scaly and coarse filiform gold	2·00	1·97	942·5	49	4 0 4
Mudgee	Fine scales and coarse grains	2·50	1·93	941·0	56	4 0 2½
,,	Coarse grains with some scales	2·00	2·04	926·0	68	3 19 0
,,	Fine and coarse scales	2·00	1·77	937·0	58	3 19 10½
Gulgong	Coarse spongy grains and some scales	2·00	1·78	938·0	58	3 19 11½
,,	Dust and coarse scales	2·00	1·78	916·5	79	3 18 3
,,	Coarse pieces—filiform and spongy	2·00	1·78	925·0	70	3 18 11
,,	Scaly, with some grains	2·00	1·59	946·0	48	4 0 7½
Carcoar	Fine scales, very porous, with some magnetic iron.	2·00	10·92	878·0	119	3 15 2
,,	Fine and coarse filiform gold of a dark colour	2·00	2·94	960·0	36	4 1 8½
Orange	Scaly	2·00	2·67	943·0	51	4 0 4½
,,	Fine dust—"gunpowder gold"	2·00	2·53	930·5	62	3 19 4
Stony Creek	Scaly	2·00	1·56	942·0	54	4 0 3½
SOUTHERN DISTRICT.						
Braidwood	Plates and fine scaly	2·00	1·79	959·0	34	4 1 7½
Araluen	Fine dust—"gunpowder gold"	2·00	2·19	951·5	42	4 1 0½
Adelong	Fine scaly and coarse filiform	2·00	2·63	944·0	52	4 0 5½
,,	Scaly	2·00	1·27	941·0	53	4 0 2
,,	Coarse filiform, with some scaly	2·50	1·69	946·0	50	4 0 7½
Tumut	Fine and coarse, with some very spongy	2·00	6·28	927·5	70	3 19 1½
Young	Scaly dust gold	2·00	2·39	957·0	36	4 1 5½
,,	Fine dust—"gunpowder gold"	2·00	1·52	943·0	49	4 0 4½
Nerrigundah	Strings, scales, and plates	2·50	1·64	980·5	15	4 3 4½
Kiandra	Scales and plates, with some grains and threads	2·00	3·15	927·0	63	3 19 1
Goulburn	Coarse grains and reticulated	2·00	6·87	975·0	22	4 2 11½
Bombala	Very fine scaly dust—"gunpowder gold"	2·00	2·63	963·0	34	4 1 11½
Cooma	Filiform crystalline and some scaly	2·00	3·17	938·0	56	3 19 11½
,,	,, ,,	2·00	4·22	924·0	70	3 18 10
NORTHERN DISTRICT.						
Nundle	Fine scaly and coarse filiform	2·00	3·33	919·5	73	3 18 6
,,	Scales, plates, and coarse filiform; of a brownish colour.	2·00	3·28	902·5	90	3 17 1½
Tamworth	Spongy, filiform, and crystalline, some with a little quartz attached.	2·00	3·28	912·0	83	3 17 10½
,,	,, ,, ,, ,,	2·00	3·31	914·0	80	3 18 0½
,,	Fine dust and shotty grains	2·00	3·31	899·5	93	3 18 10½
Armidale	Scales, with some threads	2·00	3·30	948·0	44	4 0 9
,,	Fine scales	2·00	1·91	888·5	105	3 16 0

Samples of New South Wales Gold assayed at the Royal Mint, Sydney Branch. Exhibited by New South Wales Commissioners at the Paris Exhibition, 1878.

No.	Locality.	Gross weight.	Loss per cent. in melting.	Weight assayed.	Assay Report. Gold in 10,000 parts.	Assay Report. Silver in 10,000 parts.	Standard Gold.	Fine Silver.	Value per oz. after melting. £ s. d.
1	Tamworth	2·00	3·12	1·93	9160	80	1·928	·15	3 18 1
2	,,	2·00	4·24	1·92	9160	77	1·918	·15	3 18 1
3	Armidale	2·00	3·19	1·94	7495	242	1·586	·47	3 4 8
4	,,	2·00	2·21	1·96	8895	103	1·902	·20	3 16 0
5	Goulburn	2·00	2·51	1·95	9485	43	2·018	·08	4 0 9
6	Grafton	2·00	2·82	1·94	9000	95	1·905	·18	3 16 10
7	Stroud	2·00	1·83	1·96	8500	143	1·817	·28	3 12 9
8	Tenterfield	2·00	2·00	1·96	8865	106	1·895	·21	3 15 9
9	Sofala	2·00	2·40	1·95	9435	52	2·007	·10	4 0 5
10	,,	2·00	1·37	1·97	9220	70	1·981	·14	3 18 7
11	Bathurst	2·00	1·92	1·96	9300	67	1·988	·13	3 19 3
12	Hargraves	2·00	1·33	1·97	9480	45	2·037	·09	4 0 8
13	,,	2·00	·97	1·98	9480	48	2·048	·09	4 0 8
14	Hill End	2·00	2·43	1·95	9405	54	2·001	·10	4 0 1
15	,,	2·00	3·00	1·94	9430	46	1·996	·09	4 0 3
16	,,	2·00	1·84	1·96	9445	51	2·019	·10	4 0 5
17	Mudgee	3·00	1·55	2·95	9275	68	2·985	·20	3 19 1
18	,,	2·00	8.86	1·82	9185	72	1·823	·13	3 18 3
19	Gulgong	2·00	1·26	1·98	9335	60	2·016	·12	3 19 6
20	Young	2·00	1·11	1·98	9480	48	2·048	·09	4 0 9
21	Kiandra	2·00	3·07	1·94	9265	69	1·961	·13	3 19 0
22	Braidwood	2·00	1·96	1·96	9575	38	2·047	·07	4 1 5
23	Araluen	2·00	1·34	1·97	9240	69	1·986	·13	3 18 9
24	,,	2·00	1·44	1·97	8950	99	1·923	·19	3 16 5
25	Adelong	2·00	1·29	1·98	9430	52	2·037	·10	4 0 4
26	Pyramul	2·00	1·12	1·98	9545	43	2·062	·08	4 1 3
27	Bathurst	2·00	1·74	1·97	9280	59	2·016	·12	3 19 11
28	Orange	2·00	3·00	1·94	9520	41	2·015	·08	4 1 1
29	,,	2·00	2·13	1·96	9285	68	1·985	·13	3 19 1
30	,,	2·00	3·93	1·92	8305	151	1·739	·29	3 11 2
31	Stony Creek	2·00	2·19	1·96	9425	50	2·015	·10	4 0 3
32	Parkes	2·00	2·48	1·95	8980	96	1·910	·19	3 16 8
33	,,	3·00	1·54	2·97	9250	68	2·997	·13	3 18 9
		68·00		66·44			66·611	4·84	

Alluvial Gold.

Specimens (2 oz.) exhibited by the Mining Department at the Sydney International Exhibition, 1879, assayed at the Sydney Branch, Royal Mint.

No.	Locality.	In 10,000 parts. Gold.	Silver.	Value per oz. £ s. d.
	Western District.			
1	Bathurst	9285	·065	3 17 1
2	Carcoar	9285	·060	3 16 11
3	Orange	9280	·010	3 18 5
4	,,	9400	·050	3 17 5
5	,,	9415	·050	3 17 6
6	,,	9005	·090	3 16 0
7	Hill End	9440	·050	3 19 0
8	,,	9415	·050	3 18 5
9	,,	9415	·050	3 18 10
10	Sofala	9255	·065	3 17 5
11	,,	9200	·070	3 17 2
12	Stony Creek	9390	·050	3 18 0
13	Mudgee	8870	·105	3 13 5
14	Gulgong	9490	·045	3 19 1
15	,,	9255	·065	3 17 6
16	Hargraves	9195	·070	3 15 11
17	,,	9460	·045	3 19 6
18	Wellington	8550	·135	3 11 5
19	,,	9465	·045	3 18 6
20	Parkes	9260	·065	3 16 7
21	,,	9255	·070	3 16 11
22	,,	9210	·070	3 16 0
23	Tambaroora	9485	·045	3 19 3
24	,,	9475	·045	3 19 3
25	Pyramul	9470	·045	3 19 6
49	Sofala	9205	·070	3 16 2
50	Hargraves	9510	·040	3 19 6
	Southern District.			
26	Braidwood	9585	·035	3 19 11
27	,,	9380	·055	3 18 7
28	,,	9390	·055	3 18 9
29	Araluen	9295	·065	3 18 0
30	,,	9190	·075	3 17 0
31	,,	9585	·035	4 0 0
32	,,	9290	·065	3 18 0
33	Adelong	9345	·055	3 18 0
34	,,	9540	·040	3 18 11
35	,,	9405	·055	3 18 10
36	,,	9410	·050	3 18 11
37	Nerrigundah	9725	·015	4 1 5
38	Tumberumbah	9455	·055	3 18 3
39	Monaro	9720	·020	4 0 7
40	Tuena	9373	·055	3 18 2
47	Urana	9745	·020	4 0 0
48	Cooma	9345	·055	3 17 3
	Northern District.			
41	Grafton	9185	·075	3 16 4
42	Richmond River	9525	·040	3 19 1
43	,,	9470	·045	3 19 4
44	Nundle	8985	·075	3 15 1
45	Bingera	9085	·080	3 15 3
46	Uralla	9450	·050	3 19 0

The following three tables are extracted from the report on the Southern Gold-fields by the late Rev. W. B. Clarke, M.A.

ASSAYS OF GOLD made at Sydney Mint, 1856.

Locality.	In 1,000 parts.		Copper (with trace of Iron).	Remarks.
	Gold.	Silver.		
SOUTHERN DISTRICT.				
Araluen	934·90	65·1	0·0	
,,	895·50	104·3	0·2	
,,	915·20	84·8	0·0	
,,	935·10	....	....	Bright granular gold.
,,	949·20	50·80	....	Dark coloured grains.
,,	895·90	105·10	....	Dull granular, and rough nuggets.
In broken granite 10 ft. below surface...	915·05	....	....	Bright granular gold.
Adelong	936·70	62·3	1·0	
,,	946·40	53·1	0·5	
,,	931·70	65·6	2·7	
,,	936·85	....	....	Rough, nuggety.
,,	946·45	....	....	Smaller, more waterworn,
,,	945·20	....	....	nuggety.
,,	948·60	....	....	Light coloured, fine, granular.
,,	932·00	....	....	Fine, bright, scaly gold.
,,	941·00	58·18		
Mitta Mitta	895·70	104·30		
Omeo	852·25	147·75		

ASSAYS OF GOLD made at Sydney Mint, 9 August, 1860.

KIANDRA—New South Wales.

No.	Weight of Gold Dust in oz.	Loss per cent. in melting.	Gold in 10,000 parts.	Silver.	Copper.	Net value per oz.	Remarks.
						£ s. d.	
1	200·00	5·345	9277	723	....	3 11 5–465	Rough, nuggety.
2	215·08	5·375	9258	734	8	3 11 3–347	,, ,,
3	63·94	11·307	9335	656	9	3 7 4–647	,, ,,
4	92·48	4·520	9264	717	19	3 11 11–367	,, ,,
5	67·59	4.348	9247	731	22	3 11 11–692	,, ,,
6	42·17	5·620	9377	623	....	3 12 0–192	Coarse, dull, granular.
7	31·88	4·925	9262	727	11	3 11 8–320	Mixed, granular.
Mean.	101·877	5·920	9288	701·5	9·85	3 11 1–290	

Tasmania.

Locality.	Gold in 100 parts.	Silver.	Iron.	Copper.	Tin, Lead, Cobalt, Nickel.	Remarks.
Black Boy Flat	94·76	5·04	....	....	....	Bright, granular.
,, ,,	94·95	4·66	0·08	Trace	Traces T.L.N.	Granular.
Nook, Fingal	92·55	7·10	0·17	Trace	Trace T.	Rough and fine.
Fingal	90·89	8·02	....	Trace	1·000	Waterworn nuggets.

	Specific gravity.	Gold.	Silver.	Iron.	Copper.	Bismuth.	Lead.	Silica.	Total.	Analyst.
Queensland—										
Gilbert River	......	89·920	9·688	0·070	0·128	......	0·026	......	99·832	R. Smith.
Paddy's County ...	......	92·800	6·774	0·114	0·048	trace.	0·048	... ..	99·684	R. Daintree.
Cornwall, Ladock	......	92·34	6·06	trace.	......	......	......	1·60	100·000	A. Church.
Ashantee	17·55	90·055	9·940	trace.	trace.	......	......	......	99·995	,,
Scotland, Wanlockhead	16·50	86·60	12·39	0·35	......	......	......	......	99·340	,,
Sutherlandshire	16·62	79·22	20·78	......	......	......	......	......	100·000	,,
Australia	......	99·28	0·44	0·20	0·07	......	......	0·01	100·000	Northcote.
Bathurst, N.S.W.	......	95·68	3·92	0·16	......	......	......	......	99·760	Henry.

Danas' *Descriptive Mineralogy*, p. 5.

	Specific Gravity.	Gold.	Silver.	Iron.	Copper.	Silica.	Total.	Analyst.
Wales—								
Clogau, quartz vein, No. 2....	17·26	90·16	9·26	trace.	trace.	0·32	99·74	D. Forbes.
,, ,, ...	15·62	89·93	9·24	trace.	......	0·74	99·81	,,
Mawddach River, Gwyn Fynydd wash gold.	15·79	84·89	13·99	0·34	......	0·43	99·65	,,
Cornwall, St. Austell Moor	16·52	90·12	9·05	......	......	0·83	100·00	,,
Ireland, Wicklow, wash gold	15·07 } 14·34 }	91·01	8·85	......	......	0·14	100·00	,,
Sutherlandshire—								
Kildonan Valley	15·799	81·11	18·45	......	......	0·44	100·00	,,
,, ,, ...	15·799	81·27	18·47	......	......	0·36	100·00	,,
Venezuela	......	93·58	3·69	1·60	0·65	......	99·53	Williams.
West Africa, gold grains	14·63	89·40	10·07	......	0·53	......	100·00	K. Wibel.
,, ,, ...	16·20	87·91	11·40	......	0·69	......	100·00	,,
,, gold dust	......	97·23	2·77	......	......	......	100·00	,,
,, ,, ...	......	96·40	3·60	......	......	......	100·00	,,
,, ,, ...	......	92·03	5·82	......	2·15	......	100·00	,,
,, gold dust washed from clay.	......	97·81	2·19	......	......	......	100·00	,,

Watts' *Dictionary of Chemistry*, vol. 7, p. 572.

	Gold.	Silver.
Transylvania—		
Vöröspatak	60·49	38·74
South America—		
Antioquia	64·93	35·07
Marmato	73·45	26·48
British Columbia—		
Stephen's Creek	79·50	19·70
Wales—		
Welsh Gold Mining Co.	76·40	22·78
Scotland—		
Sutherland	79·22	20·78
Wanlock Head	86·60	12·39
California—		
Mariposa	81·00	18·70
Russia—		
Borushkoi	83·85	16·15
Australia	87·78	6·07
Africa—		
Ashantee	90·055	9·940

Dr. Ure's *Dictionary of Arts*, &c., vol. 2, p. 686–7.

The average fineness of Californian gold is stated at ·880. Canadian gold usually contains from 100 to 150 parts of silver to the 1,000; but the Nova Scotian gold much less.

The average fineness of Victorian gold is about 23 carats, that is to say, it contains about 96 per cent. gold and $3\frac{1}{2}$ per cent. of silver, with about $\frac{1}{2}$ per cent. of other metals. Further north, in New South Wales, the average fineness is 22 carats $1\frac{7}{8}$ grains, or $93\frac{1}{2}$ per cent. gold and 6 per cent. silver. Still further north, in Queensland, the average fineness is but little more than 21 carats, or 87·25 per cent. gold, 12 per cent. silver. Maryborough gold only contains 85 per cent. gold and as much as 14 per cent. silver (F. B. Miller, F.C.S., *Trans. Roy. Soc., N.S.W.*, 1870.) But beyond this the northern gold again becomes richer; the gold from the Palmer River alluvial workings has a greater fineness of gold, with only small quantities of silver and other metals.

Vein gold.—The greater portion of the gold found *in situ* in New South Wales occurs in quartz veins running through the older and metamorphic rocks. Calcite is occasionally the vein-stuff. Gold is said to have been found in crystallized felspars, a most unusual matrix.

The rocks in which auriferous veins are most commonly met with are the various argillaceous slates, and chloritic and talcose schists; also in granite, as at Braidwood and Bowenfels, porphyries, and other similar metamorphic rocks; in eisenkiesel, at Carcoar. The most productive auriferous quartz veins have been found in connection with diorites, hornblendic granites, silurian slates, schists, and with serpentine. The walls and "country" of such veins are also usually auriferous to greater or less distances.

As examples of the richness of portions of gold veins, the following may be cited:—A telegram from Hill End, on February 1st, 1873, stated that at Beyers & Holtermann's mine 102 cwt. of gold had been raised in 10 tons of stuff. From the same mine a slab of vein-stuff and gold weighing 630 lbs. was exhibited which was estimated to contain about £2,000 worth of gold. Many other similarly rich blocks were also shown.

The Mint returns for the gold from 415 tons of vein-stuff from this mine were 16,279·63 ozs., value £63,234 12s. in 1873.

Krohmann's Company, also at Hill End, raised in 1873 436 tons 9 cwt. of stuff, for which the mine returns were 24,079 ozs. 8 dwts. of gold, value £93,616 11s. 9d.

Gold reefs in New South Wales have not yet been worked to any great depth. At Adelong they are getting good stone from a depth of 874 feet. The Consols Mine, Grenfell, has a depth of 716 feet; and Krohmann's Mine, Hill End, is 830 feet deep.

Associations.—The most common minerals which are found with vein gold are iron pyrites, which is never quite free from, and is sometimes exceedingly rich in gold; iron oxide, which is for the most part derived from the decomposition of various pyrites; mispickel, in calcite, as at Lucknow, where the mispickel contains in parts over 2,000 ozs. of gold per ton; also in calcite at the Crow Mountains, Barraba; at Lake Cowal; at Humbug Creek; at Grenfell; at Solferino, in the Garibaldi Reef; at Merimbula; and also, it is stated, near Gunnedah. With mispickel at Carcoar, and at Moruya with silver sulphides also; with pyrrhotine and calcite, as at Hawkin's Hill; with galena and zinc blende at Grenfell; with galena, zinc blende, magnetite, molybdenite, chlorite, and scheelite at the Williams Mine, Adelong; talc, asbestos, and serpentine near Gundagai; steatite, cuprite, malachite, tenorite, and other copper ores, notably in the Canobolas and in the Winterton Mine, Mitchell's Creek, near Bathurst, where it is also associated with barytes in well-developed, although small, crystals, and with mimetite, a chloro-arseniate of lead; it is also found with mimetite in the Adelong district; it is reported with tinstone in the cliffs at Eden, and with native arsenic at Solferino. Beautiful specimens of native gold, in malachite and red oxide of copper, have been yielded by the Kaiser Mine, Mitchell's Creek, near Bathurst.

Gold and native copper have been found together in quartz veins, and in the rocks through which the veins pass.

In alluvial deposits gold is associated in New South Wales with a very large number of minerals; and it is remarkable that certain of them, such as platinum, osmo-iridium, sapphire, ruby, oriental emerald, and diamond, have not yet been found *in situ*. Amongst other minerals we have tinstone, titaniferous iron, magnetic iron, chrome iron, brookite, rutile, anatase, emerald, beryl, topaz, zircon, hyacinth, spinelle, garnet, red and brown hæmatite, pyrites, binoxide of manganeze, galena, blende, tourmaline, magnesite, and many more of less value. Quite recently alluvial gold and metallic copper have been discovered together in some new ground opened at

the head of Whet Creek, near Mount Misery, Nundle, a specimen of which was forwarded to me by Mr. D. A. Porter, of Tamworth, on April 13, 1882. The particles of metallic copper are much smaller than those of the gold; the latter, however, do not exceed a square millimetre in area. The gold is not much water-worn, and under the microscope is seen to be distinctly crystallized in parts.

The grains of copper, although of more or less spherical form with mammillated surfaces, are in some instances distinctly crystallized.

Mr. Porter's assay of the sample gave him the following results :—

Gold	23·0
Copper	61·0
Iron oxide	10·0
Loss	6·0
	100·0

The iron oxide in the above is in the form of titaniferous iron and magnetite, smaller quantities of other minerals, usually found with alluvial gold, are also present.

The alluvial deposits are of various ages, but none of them probably are older than late tertiary age, and are often deeply buried by overflows of igneous rocks. Some are being worked to a depth of 200 feet.

Gold is found in small quantities in the tin-drifts of New England, especially in the older drifts—conglomerates or "cements," as they are termed by the miners.

Gold in the Coal Measures.

With reference to this, the Rev. W. B. Clarke made the following remarks in the 4th edition of his *Sedimentary Formations of New South Wales*, p. 9 :—

"This (*i.e.*, the occurrence of gold in the Carboniferous rocks) is thus referred to in a communication to me from Mr. Daintree, F.G.S., in a letter dated Maryvale, North Kennedy, 22 January, 1870 :—

"'I believe if the Peak Downs district were carefully mapped, it would be incontestably proved that *payable* drift gold is there found in the Carboniferous conglomerates.'

'He then gives a section of the shaft and drive then being worked at the Springs, about 12 miles from Clermont, and adds :—'The miners use the Carboniferous sandstone, the Glossopteris bed at bottom, and take the cement several inches from its junction with the Glossopteris bed for their wash-dirt. The surface of the Glossopteris bed is unbroken, dips southerly at an angle of about 5°, and the cement lies conformably on it, and little patches of mud deposit in the cement, similar in appearance to the Glossopteris sediment lie in the same plane as that bed, and I have no doubt the cement is conformable to the Glossopteris bed of the same period of deposit. Small fragments of coal were taken from the adjoining shaft, and, I have no doubt, with the necessary time given to the work, Carboniferous fossils may ultimately be found in the conglomerates themselves—so putting the matter beyond reach of dispute.'

"A similar instance of such an occurrence was examined by myself in the Coal Measure drift of Tallawang, in the county of Phillip, in the year 1875, and recognized as payable by C. S. Wilkinson, Esq., F.G.S., the present Geological Surveyor, in his report to the Minister of Mines, December, 1876, in which place there is mention of other notices by myself of like association. The localities are similar in geological structure; for almost in the words of Mr. Daintree, which Mr. Wilkinson never read, the latter says, 'These conglomerates are associated with beds of sandstone and shale, containing Glossopteris, the fossil plant characteristic of our Coal Measures.' *Annual Report of the Department of Mines for Year* 1876, p. 173."

"I made a section of the deposits which I found resting on hard shales (probably Devonian) in which numerous shallow shafts have produced alluvial gold. The bottom of the beds above the base exhibited a brecciated fragmentary deposit, well seen a mile or two away, on the road to Cobbora—above which sandstones, flinty shale, coarse grits, the red shales of Mount Victoria and Blackheath occur; and, nearer the top, Vertebraria and Glossopteris and charcoal are met with. One of the beds was of quartz-pebbles, cemented by ferruginous matter, precisely like many detrital fragments in other gold-fields, and specially resembling that above Govett's Leap, in which I obtained gold in 1863."

Mr. Clarke had previously ascertained that the Hawkesbury sandstone on the north shore of Sydney Harbour, and at Govett's Leap, contained traces of gold; and had also detected gold in the Coal Measures of the southern part of the Colony, near Shelley's Flat, Shoalhaven;* and the late Sir Thomas Mitchell also found gold in a quartz-pebble from the Carboniferous conglomerates in the year 1855, at Wingello, on the road from Braidwood.

Gold is also found in the Coal Measures near Hobart, Tasmania, and in New Zealand.

In connection with the above it is interesting to note that the Carboniferous limestone near Bristol, England, contains gold and silver. Messrs. W. W. Stoddart and Pass found appreciable quantities of both metals in the limestone at Walton, near Clevedon.

The analysis of the dried limestone gave:—

Alumina	·8777
Oxide of iron	4·8000
Carbonate of lime	94·3000
Silica	·0200
Silver	·0023
Gold	a trace
	100·000

An assay was made by Mr. J. P. Merry, of Swansea; he found in one sample 94 grains of silver to the ton, and another sample contained very nearly an ounce. The quantity of gold varied from 3 to 5 grains per ton.—See Dr. Ure's *Dictionary of Arts*, &c., vol. 4, p. 419.

The Rev. W. B. Clarke mentions that gold is found at the mouth of the Richmond River distributed in the sand and covering pebbles on the sea beach; a similar distribution is found in the sand of Shell Harbour. The black sand found in places along the coast between the Richmond and Tweed Rivers is all more or less auriferous, and after it has been concentrated by the action of storms it is sufficiently rich to pay to work. The gold is in exceedingly fine particles. Other spots give similar indications, and some specimens of gold were brought up from the sea-bottom by the sounding apparatus of H.M.S. "Herald" off Port Macquarie.

Distribution.—From the fact that gold is so widely scattered over nearly the whole of New South Wales, it would be almost an endless task to attempt to enumerate the names of all the localities at which it has been found; it must therefore suffice to refer to the names of the principal gold-fields already cited in the tables which show the proportion of silver contained by gold from various parts of the Colony, and to the mineral map published by the Government, which roughly shows the approximate area of the various gold-fields. The proclaimed gold-fields cover an area of 35,500 square miles; the workable area is probably far greater.

Amount.—The total value of gold as recorded in the Government returns from 1851 to 1881 is £34,343,857 4s. 2d.

The Discovery of Gold.—It is not my present intention to express any opinion upon the long disputed question as to who was the original discoverer of gold in Australia; but it may not be out of place to quote certain statements which have been made from time to time, so that each may judge for himself.

The first mention of the occurrence of gold in New South Wales was made as early as the month of August, 1788—the alleged discovery by a convict of the name of Dailey, however, proved to be without foundation, as he afterwards confessed that he had filed down a yellow metal buckle, and had mixed with it some gold filed from a guinea, and some earth to give it a natural appearance—*Vide* Captain Hunter's Journal, p. 84, published 1793. Mr. John White, Surgeon-general to the settlement also gives a similar account of the matter in his Journal published in 1790.

"Some convicts who were employed cutting a road to Bathurst are said to have found gold in a considerable quantity, and were only compelled to keep silence on the point by menaces and floggings, 1814."—Heaton's *Australian Dictionary of Dates*, p. 109. [These statements were probably true, since the last portions of the road pass through what has since proved to be gold-bearing country.]

"A convict flogged in Sydney on suspicion of having stolen gold, which he stated he had found in the bush, 1825."—*Ibid.*

* "Southern Gold-fields," W. B. Clarke, pp. 43, 44, and 245. Sydney, 1860.

The *Evening News* of Sydney for 7th August, 1875, contains the following statement with respect to the original discovery of gold:—"We are in a position to show that gold was discovered, and we believe officially reported to the Government, upwards of fifty-two years ago, viz., on the 16th February, 1823. On that date Mr. Assistant-Surveyor James M'Brian discovered the precious metal at a spot on the Fish River, about midway between O'Connell Plains and Diamond Swamp, a little to the north of the old Bathurst Road, and about 15 miles east of Bathurst. We have now before us an extract from Mr. M'Brian's field book, which book is preserved in the Surveyor General's Office. It reads as follows:—"February 15, 1823. At 8 chains 50 links to river, and marked gum-tree. At this place I found numerous particles of gold in the sand and in the hills convenient to the river."

It is stated in a Sydney paper that Mr. Cohen, a silversmith of Sydney, purchased a piece of auriferous quartz from a labouring man in December, 1829.

Mr. Davison mentions in his book on *The Discovery and Geognosy of Gold Deposits in Australia*, London, 1860, that a servant of Mr. Low's had, in 1830, found a specimen of gold several ounces in weight on the Fish River; nearly in the same locality as Mr. Assistant-surveyor M'Brian.

In reference to the early discovery of reef gold, Mr. Wilkinson makes the following remarks (*Annual Report of the Mining Department, 1877*, p. 202):—

"In one of the reefs in diorite, near the summit of Diamond Hill, it is said that gold in quartz was discovered in 1823. Mr. J. Willard Low, of Sidmouth Valley, informed me that in that year, in his presence, his father (Mr. Robert Low) and Lieutenant W. Lawson, while collecting some specimens of quartz crystals from the reef, found one specimen of quartz containing a piece of gold of the size of a pea; to make sure that it was gold, these gentlemen are said to have had the specimen tested. It is also interesting to observe that on the Fish River, about 2½ miles north from this spot, Mr. Assistant-surveyor M'Brian, when engaged on the survey of the river, on the 15th February, 1823, stated that he discovered gold."

Count Strzelecki found gold, associated with pyrites, in 1839, in the Vale of Clwydd.

The two following letters were published in the *Sydney Morning Herald* of 17 May, 1851, and are of very great interest in connection with this question as to the first discovery of gold:—

"To the Editors *Sydney Morning Herald*.—Gentlemen,—Whilst reading this afternoon the leading article headed 'Gold,' in your number of to-day, I felt convinced that Count Strzelecki must be entitled to more credit as a discoverer of gold ore in this Colony than had therein been accorded to him; for the belief was strong in my mind that previously to 1840 he had himself informed me of its existence in the country west of the Blue Mountains.

"Searching this evening amongst my old letters, I have luckily met with one addressed to me by the Count in 1839, which I think proves, at all events, that its existence was then fully believed in by him, and had been at least *scientifically discovered by and known to him*, and this, as far as his fame as a geologist is concerned, is, I conceive, the gist of the matter, and of more consideration than if by accident or otherwise he had actually picked up a specimen of the precious metal.

"In justice to a highly accomplished and much esteemed gentleman and man of science, to whom the Colonists are much indebted for his arduous and gratuitous researches and labours in the field of Australian geology, I shall be glad if you will publish the extract from his letter to me. I am, gentlemen, your obedient servant.—THOMAS WALKER.

"Fort-street, May 15, 1851."

"Wellington, 16th October, 1839.

"My dear sir,—I write you this from Wellington and on my knee, as it happens that in the place the epistolary fit has taken hold of me there is no table, but in compensation plenty of petrified bones, which I excavate here with my hands—bones, may be, of hippopotamus, or some other species which once was in this part of the world and is no more. I find the Wellington Caves far superior to the Boree ones, and most interesting, but frightfully absorbing my time. I say frightfully, because, thinking of what little I have seen of the Colony, and what still remains to be explored, I shudder.

"The distances, too, extend themselves most provokingly under my pursuits—for instance, the distance between Wellington and Sydney, 180 miles, but it was in 420 miles I accomplished it, in true zig-zag rambling, scrambling, and occasionally starving. But seeing much, and surveying barometrically a great track, and securing for mineralogy and geognosy a pretty considerable number of notes; this I accomplished every inch on foot, carrying a weight of 40 lbs.

"You may take it for granted that between Sydney and the 'Dividing Range,' in the direction of Bathurst, and in the width of 60 miles, there are no metals except iron; no minerals of any consequence but alum in its native state; carburet of iron (black lead), and plenty of coal. Not far from Mount Hay there is a thermal spring of chalbeate water, strongly impregnated with carbonic acid—most beneficial to health impaired by dyspepsia or nervous affection, but as fate would have it, threatening to kill by the exhausting fatigue of the journey whomsoever should attempt to get at it.

"On this side the Dividing Range the variety of rocks and imbedded minerals augment—indications most positive of the existing silver and gold veins are met with. The want of means, however—that is, time and men—did not allow me to trace them to their proper sources. Why has the Government not sent heretofore a man of science, and mineralogical and mining acquirements, to lay open these sources of health still hidden beneath, and which may prove as beneficial to the State and individuals as the rest of the branches of Colonial industry? Believe me yours most truly.—P. E. De Strzelecki.

"Thomas Walker, Esq."

The following extract from a letter written by Count Strzelecki to Captain P. King, R.N., also dated from Wellington, but ten days later, viz., 26 October, 1839, and quoted by Judge Therry in his book entitled *Thirty Years' Residence in New South Wales*, is another account in Count Strzelecki's own words of his share in the discovery of gold:—

"I have specimens of excellent coal, some of fine serpentine with asbestos, curious native alum, and brown hæmatite, fossil bones, and plants, which I digged out from Boree and Wellington caves, but particularly a specimen of native silver in hornblende rock, and *gold in specks in silicate*, both serving as strong indications of the existence of these precious metals in New South Wales. It was beyond my power to trace these veins or positively ascertain their gauge. I would have done so with pleasure, *pro bono publico*, but my time was short, and so were the hands. I regret that the Government, having reserved all the mines for its benefit, did not send here a scientific man truly miner and mineralogist, to lay open these hidden resources, which may prove as beneficial to the State and individuals as the rest of the branches of the colonial industry."

The reasons why Count Strzelecki did not follow up his discovery are also given by himself as follows:—

"I was warned of the responsibility I should incur if I gave publicity to the discovery, since, as the Governor argued, by proclaiming the Colonies to be gold regions the maintenance of discipline would be impossible. These reasons of State policy had great weight with me, and I willingly deferred to the representations of the Governor General, notwithstanding that they were opposed to my private interests."

With reference to the important part which the Rev. W. B. Clarke played in the discovery of gold in Australia, I cannot do better than quote the words of Professor Geikie, F.R.S., who, in his *Life of Murchison*, says:—Count Strzelecki appears to have been the first to ascertain the actual existence of gold in Australia; but, at the request of the colonial authorities, the discovery was closely kept secret. The first explorer who proclaimed the probable auriferous veins of Australia on true scientific grounds, that is, by obtaining gold *in situ* and tracing the parent rocks through the country, was the Rev. W. B. Clarke, M.A., F.G.S., who, originally a clergyman in England, has spent a long and laborious life in working out the geological structure of his adopted country, New South Wales. He found gold in the Macquarie Valley and Vale of Clwydd in 1841, and exhibited it to numerous members of the Legislature, declaring at the same time his belief in its abundance. While, therefore, geologists in Europe were guessing, he, having actually found the precious metal, was tracing its occurrence far and near on the ground."

The Rev. W. B. Clarke gave the following evidence before a Select Committee of the Legislative Council, 24 September 1852. *(Vide Parliamentary Papers)*:—

"*Q.* Have you any objection to state to the committee when your attention was first directed to the existence of gold in this country? *A.* It was in 1841, when I crossed the Dividing Range to the westward of Parramatta, in endeavouring to satisfy myself as to the extent of the Carboniferous formation in that direction, that I first became aware of the existence of gold in Australia, by detecting it at the head of the Winburndale rivulet, and in the granite westward of the Vale of Clwydd.

"*By Mr. Holroyd*: Did you go further to the westward? *A.* No; I had satisfied myself as to the object of my journey, and returned home. At that time I knew nothing of the history of gold; but since then I have obtained every information I could upon the subject. There are many persons living who know that I, very shortly afterwards, began to speak of the abundance of gold likely to be found in the Colony, and that as early as 1843 I mentioned it generally. On the 9th April, 1844, I also spoke to the then Governor, Sir G. Gipps, and exhibited to him a sample, but without any result as to further inquiry. The matter was regarded as one of curiosity only, and considerations of the penal condition of the Colony kept the subject quiet, as much as the general ignorance of the value of such an indication. In that year I exhibited the gold, and spoke of its probable abundance, to some of the then members of the Council; and one of them, the late Mr. Robinson, replied to me, 'You ought to have been a miner,' but took no further notice of it. The only one who seemed to take much interest in the subject was His Honor Mr. Justice Therry. I am able to fix the date of the time when I spoke to Sir G. Gipps by the recollection that I spent that day with him at Parramatta, and that it was the day on which a certain great meeting of squatters was held in Sydney.

"*Q.* What was the character of the gold you found? *A.* It was embedded in a matrix of quartz, and also, as it is generally found in granite, in small flakes. I did not find alluvial gold.

"*Q.* Did you make it known to any of your scientific friends in England? *A.* Not at the time at which it was found, but I have written to my friends often since; and Sir R. Murchison has quoted from one of my letters to him in an article published by him in the *Quarterly Review*, of September, 1850. The editors of the *Illustrated Australian Magazine*, published at Melbourne, 1851 (October), state also that they had seen letters written by me to my friends in England, ten years ago, which proved that I knew the country to be auriferous (p. 211). I do not mention these facts for the sake of speaking of myself, but to substantiate my claim to have declared the auriferous character of this country many years ago, before the present gold workings began, and in consequence of the jealousies which have arisen respecting my knowledge and investigations of it.

"*By the Chairman:* How much gold was there in the specimens you found in 1843? *A.* The weight of one specimen was about a pennyweight; it was what might be termed a fair sample.

"*Q.* Did you find any other specimens afterwards? *A.* I had no opportunity of revisiting the localities; my official duties prevented me, and when I had opportunities of again going away on detached duties, it was altogether in other directions. It was always my intention, had occasion allowed, to make a close investigation of that district.

"*By Captain King:* Did you ever hear that Count Strzelecki had found gold at Bathurst? *A.* No, I never heard of his having found gold at all until last year, 1851 (June, I believe), when I read a letter published by Mr. Walker in the *Herald* newspaper, in which Strzelecki stated that he had found indications of veins of gold and silver near Wellington. There is no mention whatever of gold in his *Physical Description*, which was published in 1845; and in the geological report of his journey to Mount Kosciusko and Gipps Land, printed in the *Parliamentary Papers*, the only allusion he makes to gold is in his notice of auriferous pyrites, which he says was too insignificant to be regarded commercially.

"*By Mr. Holroyd:* Did you obtain your specimens from the creek or were they brought to you? *A.* The gold of which I have spoken as having first led me to the knowledge of the existence of the metal in New South Wales I obtained myself.

"*Q.* Did you break off any more quartz? *A.* No; I was not looking for gold; my object at that time was different. I was not then aware that other persons had found gold in various places of the western country.

"*By the Chairman:* Were you aware of its containing gold until you returned home? *A.* I knew it was gold, but I did not at first see what it indicated.

"*By Mr. Holroyd:* You did not prosecute the investigation any further? *Q.* Not at that time; I merely regarded it as a mineralogical discovery."

In 1844 Sir Rod. Murchison pointed out the similarity of the Blue Mountain Chain of Australia, the Cordillera, to that of the Ural, and predicted the occurrence of gold. His prognostications, 1844–6–7, appear* to have been the first published. Colonel Helmerson, a member of the Imperial Academy of Sciences, St. Petersburg, who was well acquainted with the Ural Gold-fields, also expressed at this time a similar belief in the existence of gold in Australia.

In the Report of the Commissioners of the International Congress of Australian statistics, held in London in 1861, it is stated that:—"The first known discovery of the precious metal was made by Count Strzelecki in 1839, and was mentioned by him to some personal friends and to Sir George Gipps, the then Governor of the Colony of New South Wales. It was again discovered and specially noticed by the Rev. W. B. Clarke, of Sydney, in 1841. The attention of the colonial public, however, was not attracted to the subject until the existence of an extensive gold-field throughout Australia was announced by Mr. E. H. Hargraves in 1851. A long time previous to this announcement, namely, in 1844, and without being aware of the finding of specimens of the precious metal by Count Strzelecki and the Rev. W. B. Clarke, Sir R. Murchison publicly asserted the high probability of the existence of gold in Australia. This bold induction was based on his knowledge of the geological formation of that country. And the wonderful results of gold-mining in Victoria and New South Wales afford a proof of scientific sagacity almost unparalleled in the history of science.

"JAMES MACARTHUR,
"EDWARD HAMILTON, New South Wales.
"STUART A. DONALDSON,
"M. A. MARSH, Queensland.
"WILLIAM WESTGARTH, Victoria.
"EDWARD STEPHENS, South Australia.
"JAS. A. YOUL, Tasmania.
"J. E. FITZGERALD, New Zealand.

"*Offices of the Congress:*—Somerset House, London, 18 July, 1860."

Simpson Davidson, in his *Gold Deposits in Australia*, p. 27, says:—

"During all the time (apparently from 1847 to 1849) of my being at Goodgood, the very crystallinic character of the mica schist continued to attract the attention not only of myself, but also of the shepherds, who were continually bringing specimens to me to ask if it were not gold, or an indication of it, and amongst others whom I had lately engaged as a shepherd was one by name Thomas Appleby. This man had seen better days, and had had a great deal of experience in the Colony. He was besides gifted with strong, natural good sense, and intemperate habits alone had reduced him to the necessity of servitude in this humble capacity. Appleby was always disposed to look for gold at Goodgood, and I think it likely he may have lived in the Western Districts, about the Wellington Valley, since he was not only acquainted with the fact of a shepherd in that neighbourhood having found gold during a number of years past, and of having effectually concealed the fact from the authorities, but he described very correctly the manner in which the fortunate shepherd got his gold, by breaking up 'white flint, just such as this, sir,' as Appleby one day said, while picking up at the same time the quartz pebbles which were scattered about in tolerable abundance on the Goodgood Run, in addition to the compact quartz veins to which I have already alluded.

"Appleby was not the first man who mentioned to me the secret of the gold-finding shepherd, for the fact of a shepherd habitually finding gold was known, I venture to say, to every other shepherd in the Colony of two years' standing. The tradition had passed from shepherd to shepherd, and whilst the Government and the men of science, as it afterwards appeared, either were, or affected to be, ignorant of the circumstances, the facts were universally spoken of at this time in the pastoral districts, though they might be but little heard of amongst the Sydney

* Royal Geographical Society's volume for 1845. *Trans. Royal Geological Society of Cornwall, 1846. Report of the British Association, 1849.*

citizens. But Appleby described the manner in which the lucky shepherd obtained his gold more circumstantially and more correctly than any other person I met with, and I think that he must either have collected his information from the immediate neighbourhood of Wellington, or it may have been from an actual personal acquaintance with the gold-collecting shepherd himself."

Page 275.—"It should also be stated that the Mr. Smith who is mentioned purchased the gold, which it appears he sent to Sir R. Murchison in England, for he never discovered any gold in Australia himself. Mr. Smith is chiefly known in the Colony as having exhibited to the Colonial Secretary a lump of gold, found by a shepherd about the year 1846 in the very neighbourhood where Mr. Hargraves washed out the first gold on Summer Hill Creek. This shepherd only found one piece of gold, and could never find any more (on p. 356 Mr. Davison states that at the time it was supposed by most people to have been melted down from stolen jewelry); but another shepherd—the more notorious Macgregor—had collected at various times numerous pieces near Wellington, about 50 miles distant from the former place, and I presume that some of these may have been the specimens which came into possession of Mr. Smith and Mr. Phillips, and were by them forwarded to Sir Roderick Murchison in 1848, since neither of these persons claim to be actual gold-finders."

And at *page 340.*—"Although the existence of gold in New South Wales was known for many years past to scientific men, yet it is generally admitted that Macgregor was the first person who found it in remunerative quantities. In the scramble for notoriety, which occurred several years subsequent to Macgregor's success, his claims were overlooked or set aside by those who laboured through the Press and elsewhere to enforce their own demands, and he, being a man of humble position, and of unobtrusive habits, made no endeavour at the time to establish a priority so justly his due. Macgregor, now a wealthy man, was formerly a shepherd in Mr. Montefiore's establishment at Wellington. His flock fed over land situated on Mitchell's Creek, and possessing a geological turn of mind, and from the nature of his occupation—abundant leisure to prosecute research—he was led to break up and examine portions of a quartz ridge which traversed his sheep run. During this investigation he met with a metal (amongst several others) which he supposed to be gold, and forwarded a sample of it to Sydney. The result proved the correctness of his opinion, and thenceforth he devoted the whole of his available time to the accumulation of the precious metal. The shepherd was ordinarily a prudent man, but becoming enamoured of a young woman he revealed to her the secret of his wealth, and produced ample proofs of its reality. From this moment ceased the monopoly which he had enjoyed undisturbed for some years; the circumstances with his discovery gradually became known to the public, and the local excitement was intense. The quartz ridge and its neighbourhood were visited by hundreds eager in the pursuit, all of whom were enabled to bear away an auriferous fragment. Dr. Curtis communicated the facts to Sir George Gipps, but failed to direct official notice to the locality; and ultimately Macgregor left the district (to which he is yet an occasional visitor) in search of other gold-fields. The excitement of the good people of Wellington is at present little less than it was in Macgregor's time, from the fact of these identical lands being now in the market. They consider, and with probability, that an opportunity will now be afforded for testing the auriferous capabilities of the immediate vicinity of the township. Three sections of 640 acres each are to be submitted for sale on the 29th of April instant, at Wellington, and the result is looked forward to with impatience. Copper and other ores have been also found here, in addition to which the lands are of the highest character, probably the best in the country for agricultural purposes, being watered by Mitchell's Creek."

Again on *page 348.*—"By inquiring on the spot I have learnt that Macgregor had collected altogether, gold of the value of about two hundred pounds sterling, previously to the discovery of gold in placer-deposits. This sum may appear small, but considering that it was entirely obtained by breaking the surface quartz with a hammer, while following the occupation of sheep tending, I should think that it not improbably represented a thousand separate instances of gold-finding, between the year 1840 and 1850."

Mr. Davison also mentions that in June, 1849, there appeared an article in a Sydney journal headed "Port Phillip a Gold-field," with a circumstantial account of some youth having found a lump of gold between Melbourne and the Pyrenees. The statement was a good deal doubted at the time, but the account was perfectly true.

The above statement was made, Mr. Davison says, while he and Mr. E. Hammond Hargraves were detained, by the weather, in Sydney Harbour, on board the barque "Elizabeth Archer," then bound for the gold-fields of California.

In a pamphlet on *Gold and the Gold-fields*, by James Wyld, London, occurs the following statement, *p.* 32 :—"Mr. Francis Forbes, of Sydney, about two years ago published and circulated in New South Wales a paper, in which he affirmed in the strongest manner, on scientific data, the existence of gold formations in New Holland. Mr. Forbes, not being listened to nor encouraged in his researches, went to California, where he died in 1850."

On June 23rd, 1875, some articles and letters referring to the discovery of gold appeared in the *Parkes Gazette*, in which it is stated that Mr. John Phillips announced the discovery of gold in 1847. A letter, dated from Jermyn-street, 16 July, 1855, from Sir Rod. Murchison to Sir Chas. Hotham, is cited, which states that "Mr. Phillips is the person who first announced to me that he had detected it (gold) in your Government (1847). I so stated the fact in my letter of 1848 to the Colonial Secretary (Lord Grey), when I urged upon H. M. Government to take the initiative in developing the auriferous resources of the region."

Mr. Austin brought to Sydney a nugget of gold, worth £35, which he had found in the Bathurst district, January, 1851.—Heaton's *Dictionary of Dates.*

The following extract is from a lecture upon the Geology of Australia by the late Prof. Beete Jukes, F.R.S. :—*

"Some of Sir R. Murchison's observations, having found their way to the Australian papers, a Mr. Smith, engaged at that time in some ironworks at Berrima, was induced by them in the year 1849 to search for gold, and he found it. He sent the gold to the Colonial Government, and offered to disclose its locality on payment of £500. The Governor, however, not putting full faith in the statement, and being, moreover, unwilling to encourage a gold fever without sufficient reasons, declined to grant the sum, but offered, if Mr. Smith would mention the locality, and the discovery was found to be valuable, to reward him accordingly. Very unwisely, as it turns out, Mr. Smith did not accept this offer, and it remained for Mr. Hargraves, who came with the prestige of his Californian experience, to remake the discovery, and to get the reward from Government on their own conditions."

The Rev. W. B. Clarke says in his *Plain Statements*, 1851, p. 7, that Messrs. Macgregor, Stewart, Trappitt and others found gold prior to Mr. Hargraves. There is considerable evidence to prove that gold was several times obtained in Victoria and publicly exhibited in Melbourne in 1848 and 1849.

To Mr. Hargraves in 1851 was reserved the satisfaction of showing that gold existed in great quantities in various parts of the Colony and that it could be readily obtained from alluvial deposits by means of the cradle.

RETURN showing the Quantity and Value of Gold produced in the Colony of New South Wales. From the *Annual Reports of the Department of Mines*, Sydney.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	ozs.	£		ozs.	£
1851	144,121	468,336	1867	271,886	1,053,578
1852	818,751	2,660,946	1868	255,662	994,655
1853	548,052	1,781,172	1869	251,492	974,149
1854	237,910	773,209	1870	240,858	931,016
1855	171,367	654,594	1871	323,610	1,250,485
1856	184,600	689,174	1872	425,130	1,643,582
1857	175,949	674,447	1873	361,785	1,395,175
1858	286,798	1,104,175	1874	270,823	1,040,329
1859	329,363	1,259,127	1875	230,883	877,694
1860	384,054	1,465,373	1876	167,412	613,190
1861	465,685	1,806,172	1877	124,111	471,418
1862	640,622	2,467,780	1878	119,665	430,033
1863	466,111	1,796,170	1879	109,650	407,219
1864	340,267	1,304,926	1880	118,600	441,543
1865	320,316	1,231,243	1881	149,627·06	566,513
1866	290,014	1,116,404			
			Total		£34,343,857

* Lectures on Gold, delivered at the Museum of Practical Geology, p. 32. London, 1852.

Silver.

Native Silver.

Native silver crystallizes in the cubical system; specific gravity 10·1 to 11·1. It does not appear to have been found in any quantity in New South Wales.

The Rev. W. B. Clarke mentions in his "Southern Gold-fields," published in 1860, that silver had been met with in the southern districts in two or three places in the form of small fragments, and arborescent crystals. The same author mentions finding a thin plate of flexible silver having a specific gravity of 10.

Count Strzelecki makes the following mention of the occurrence of native silver on Honeysuckle Range, from Piper's Flat,* in New South Wales in 1839:—"Silver (native) in very minute and rare spangles, disseminated in primitive greenstone * * * deserving further researches." Native silver is said to occur also in the Boorook Mines, with the chloride, sulphide, and other ores of silver; and at Calton Hill, Dungog, Hunter and Macleay District; and Warril Creek, to the north of Kempsey.

A small plate of silver was found by Mr. C. Suttor, junior, in the quartz of a vein containing galena, on the Mount Grosvenor Estate, near Bathurst.

Argentite.—Silver Glance.

Chem. comp.: Sulphide of silver AgS; silver, 87·1 S 12·9 = 100. Crystallizes in the cubical system; specific gravity, 7·19 to 7·36.

This ore has been found with iron pyrites in quartz, also in limestone on the Clarence and Manning Rivers. It occurs also at two or three places near Bathurst, in the county of Bathurst; at Copper Hill; at Brownlea; on the Page and Isis Rivers, Upper Hunter, in the county of Brisbane; and at Brunaby Creek, in the county of Argyle. With cobalt, zinc and iron at Broulee, Moruya, in the county of Dampier; at Teesdale, county of Bathurst; on the Queanbeyan River, county of Murray; at Burra Creek, county of Selwyn; on the Yass River and Burrowa Creek, county of King; at Buckinbah, county of Gordon; at Tacking Point, county of Macquarie; and on the Crookwell River, county of Georgiana. With gold, lead and zinc at Gulgong; with carbonate of lead at Peelwood; with galena and iron pyrites at Shellmalleer; on the Molonglo River, near its junction with the Murrumbidgee; and at the junction of Murrumbidgee Creek with Mountain Creek, in the county of Murray. In nearly all cases the silver sulphide occurs, mixed more or less intimately with galena, so that properly it should usually be termed argentiferous galena. It occurs with galena on Brookes' Creek, Upper Gundaroon, in the county of Murray, and Adelong, in the county of Wynyard; with fluorspar and galena at Woolgarloo; with galena at Wellingrove, in the Glen Innes District; at Grenfell, in the county of Monteagle; and Araluen, in the county of St. Vincent. The silver-bearing lodes at Yarrahappini, Warrell, run through granite and Devonian rocks; the vein-stuff consists of quartz, containing mispickel, zinc blende, iron pyrites, and galena, but up to the present these veins have not proved payable.

The richest silver veins at present known exist at Boorook, about 20 miles to the north-east of Tenterfield, distant some 30 miles by the road; the veins are said to run through slate and "felspar porphyry," and the silver minerals are associated with quartz, oxide of iron, and iron pyrites, often rich in both silver and gold. In the upper portions of the lodes the silver seems to be mainly present as chloride; below, at a depth of 110 feet or 120 feet, it changes for the most part into silver sulphide.

At the Golden Age Mine the vein is composed of a porous quartz, with chlorite, clay, and much oxide of iron, and the ore is principally the chloride down to 80 feet, below which it changes to sulphide, mixed with argentiferous pyrites and zinc blende. The rock or country is described as a blue shale, or soft slate in parts fossiliferous.

Some of the ore from the Boorook Mines contained as much as 800 ozs. of silver and 5 ozs. of gold to the ton; most of the gold is in the free state.

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* *Physical Description of New South Wales and Van Diemen's Land,* by P. E. de Strzelecki, London, 1845.

Antimonial Silver Ore.

The compositions of the antimonial silver compounds hitherto met with have not yet been worked out. Some of the silver ore from Boorook is in part an antimonial one, mixed with the chloride, sulphide, and perhaps arseniate of silver; associated with this mixed ore are found native gold, iron oxide, iron pyrites, copper pyrites, chlorite, quartz, and other minerals.

An arsenical compound of silver and antimony occurs at Moruya.

The following analyses, made by Mr. W. A. Dixon, for the Mining Department in 1879, will serve to show the composition of some of the mixed silver ores:—

Stone from Mr. J. Moffat's property, Boorook:—

Silica	97·710
Iron	·791
Zinc	traces
Lead	·023
Copper	traces
Antimony	·125
Silver and gold	·004
Sulphur	·324
Water	·762
Oxygen and loss	·261
	100·000

Gold, 1 dwt. 14 grs. per ton; silver, 1 oz. 11 dwts. 5 grs. per ton. Calculated into its proximate constituents this analysis gives—

Silica	97·710
Sulphide of antimony	·174
,, ,, silver	·004
,, ,, lead	·026
,, ,, iron (FeS_2)	·485
Oxide of iron	·823
Water	·762
	99·984

Stone from the Grand Junction Reef, Boorook:—

Silica	91·765
Antimony	·132
Arsenic	traces
Gold	·011
Silver	·129
Lead	1·492
Copper	·047
Zinc	·477
Iron	2·631
Sulphur	1·552
Water	1·008
Oxygen and loss	·756
	100·000

Gold, 3 ozs. 16 dwts. per ton; silver, 42 ozs. 4 dwts. 10 grs. per ton. Calculated with its proximate constituents the above analysis gives—

Silica	91·765	
Sulphide of antimony	·184	
Gold	·011	
Sulphide of silver	·148	
,, ,, lead	1·722	
,, ,, zinc	·715	
,, ,, copper Cu_2S.)	·060	Copper pyrites 0·142
,, ,, iron (Fe_2S_3)	·082	
,, ,, ,, (FeS_2)	1·774	
Oxide of iron	2·507	
Water	1·008	
	99·996	

KERARGYRITE.—Horn Silver.

Chem. comp.: Silver Chloride, AgCl. Silver, 75·3; Chlorine, 24·7 = 100·0.

Specific gravity, 5·31 to 5·55.

Crystallizes in the cubical system, often has the appearance of and cuts like wax. Fuses in the candle flame. Said to occur in a vein near Braidwood and within 2 or 3 miles of Queanbeyan.

Occurs at Boorook, especially in the upper portion of the veins.

BROMARGYRITE.—Silver Bromide.

Chem. comp.: AgBr. Silver, 57·4; Bromine, 42·6 = 100·00.

Not yet reported; but the following compound of silver with chlorine and bromide is reported from Mitchell's Creek.

EMBOLITE.—Silver Chloro-bromide.

Chem. comp.: AgClBr. The proportion of silver varies from 61 to 72 per cent. Specific gravity, 5·31 to 5·81.

Crystallizes in the cubical system. Found at Winter & Morgan's Mine, Mitchell's Creek, Bathurst.

RETURN showing the Quantity and Value of Silver produced in the Colony of New South Wales. The *Annual Report of the Mining Department*, Sydney.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
		£			£
1862	266 tons ore	say 5,320	1872	49,545 ozs.	12,663
1863	28 ,,	1,080	1873	66,998 ,,	16,278
1864	13 ,,	130	1874	78,027 ,,	18,880
1865	736 ozs.	184	1875	52,553 ,,	12,794
1866	....	....	1876	69,179 ,,	15,456
1867	....	....	1877	31,409 ,,	6,673
1868	....	....	1878	60,563 ,,	13,291
1869	753 ozs.	199	1879	83,164 ,,	18,071
1870	13,868 ,,	3,801	1880	91,419 ,,	21,878
1871	71,312 ,,	18,681	1881	57,254 ,,	13,026
			Total		£178,405

Most of the silver produced in New South Wales is obtained in the refining of gold at the Mint.

PLATINUM.

NATIVE PLATINUM.

Crystallizes in the cubical system.

Specific gravity, 16—19.

Reported to occur with gold in the Shoalhaven River, county of Dampier; in the Ophir gold district, county of Wellington; in the form of small grains at Bendemeer, county of Inglis; and at Calton Hill, Dungog, in the Hunter and Macleay District, county of Durham. A small nugget, weighing 268 grs., and having a sp. gr. of between 15 and 16, was obtained from Wiseman's Creek, county of Westmoreland, with alluvial gold.

A small quantity of platinum occurs in the sand along the sea-coast, near the Richmond River; an assay of some by Mr. W. A. Dixon* gave—

Gold	1 dwt. 5 grs. per ton
Platinum	Less than 5 grs. ,,

* *Vide Annual Report of Mining Department*, 1878, p. 43.

Analyses of Australian Platinum.

	No. 1.	No. 2.
Platinum	59·80	61·40
Gold	2·40	1·20
Iron	4·30	4·55
Iridium	2·20	1·10
Rhodium	1·50	1·85
Palladium	1·50	1·80
Copper	1·10	1·10
Iridosmine	25·00	26·00
Osmium	·80	——
Sand	1·20	1·20
	99·80	100·20

St. Claire Deville and Debray, Ann. Ch. Phys. III, lvi. 449.

Rhodium.

It is stated, in the catalogue of Natural and Industrial Products of New South Wales, exhibited by the Paris Exhibition Commissioners, 1854, that the iron ore from Nattai contains both rhodium and nickel, together with traces of antimony and gold.

Osmium and Iridium.

Osmo-Iridium or Iridosmine.

This compound of osmium and iridium is very commonly met with in the auriferous and other drifts of New South Wales in the form of minute grains and scales. The area over which it is found may be regarded as roughly corresponding with those of the alluvial gold deposits.

I have observed it in fair quantities in the gem sand at Bingera, county Murchison; Mudgee, county Phillip; Bathurst, county Bathurst; and other places.

Its presence in alluvial gold is occasionally a source of trouble at the Mint, for minute grains are often mechanically enclosed by the gold after melting, which by their hardness speedily destroy the dies during the operation of coining.

The following analysis is given of a specimen of this alloy, but no particulars are afforded as to the exact locality.

Analysis of Australian Iridosmine.

Iridium	58·13
Rhodium	3·04
Platinum	....
Ruthmium	5·22
Osmium	33·46
Copper	·15
Iron	....
	100·00

Deville & Debray, Ann. Chem. et Phys. III, lvi., p. 481.

Mercury.

Native Mercury.

The Rev. W. B. Clarke stated that he received his first sample of native quicksilver in 1841 from near Carwell Creek, on the Cudgegong River, in the county of Phillip, where cinnabar occurs.

It has also been found in the Mookerawa Creek, and Great Waterhole at Ophir, in the county of Wellington, mentioned by Stutchbury; and in his report he stated that mercury had never been used on that creek.

Native mercury is said to occur in the casing of the reef at the Clifton Mine, Boorook. Mercury is also said to have been detected at Wagonga,* county of Dampier, in a bed some 10 feet thick, and situated some 90 feet above the sea-level.

* See *Mines and Mineral Statistics of New South Wales*, 1875, p. 201.

Cinnabar.

Chem. comp. : Mercury, 86·2; sulphur, 13·8 = Hg. S. Found on the Cudgegong River, some 25 miles from Mudgee, county of Phillip, in an argillaceous matrix, and in alluvial deposits associated with gold, gems, and other similarly occurring minerals, in the form of small rounded masses of a brilliant red colour. The Cudgegong Mine is no longer being worked. Reported also to occur at Moruya, county of Dampier. Cinnabar is reported with gold, silver, and copper on Grove Creek, Abercrombie Mountains.

Copper.

Native Copper.

Cubical system. Crystallized native copper is by no means rare, but large and well developed crystals, as elsewhere, are uncommon. It is met with massive, in plates, threads, wires, and arborescent forms, the latter being usually built up of elongated rhombic dodekahedra. I have been unable to find any analysis of New South Wales native copper, but it probably contains the usual small quantities of silver, lead, bismuth, and other metals.

In nearly all cases it is found in association with cuprite, malachite, and other oxidized copper ores, as at Carcoar and Bathurst, county of Bathurst; the Canoblas and Wellington, county of Wellington; Mitchell's Creek, Bell River, county of Roxburgh; Peel River, county of Inglis; the Belara Mine, 20 miles from Gulgong, county of Phillip; Manilla, county of Darling; Bingera, county of Murchison; Cobar, county of Robinson; Pink's Creek; the Peabody Mine, county of Ashburnham; Copper Hill, Pierce's Knob; and Mount Lyell, near the Stanley Ranges, county of Farnell. It occurs with smaragdite on Molong Creek, and with porphyry at Parkes, county of Ashburnham; at Peelwood, county of Roxburgh, with lead ores; and in the form of diffused grains in a dark grey phonlite, near Kiama, county of Camden. Quite recently it has been found with alluvial gold near Nundle.

Cuprite—Red Copper Ore.

Chem. comp. : Copper suboxide = Cu_2O; copper, 88·8; oxygen, 11·2 = 100. Usually found massive, but occasionally well crystallized in cubes and octohedra, which, however, are seldom more than $\frac{1}{4}$ inch in diameter.

The variety crystallized in capillary crystals, known as chalcotrichite or plush copper, is met with at the Coombing Mine, near Carcoar, county of Bathurst. The largest and best crystals I have seen have come from the Cobar Mine.

This mineral is usually associated with the other oxidized copper ores, such as malachite and chessylite.

It is abundant at Cobar, county Robinson, both massive and crystallized; Clarence River, county Clarence; Gordon Brook, county Richmond; Cowra, Carcoar, Milburn Creek, Cow Flat, and the Bathurst district, county Bathurst; Mitchell's Creek, county Roxburgh; Wiseman's Creek, county Westmoreland; Icely; Burrowa, county King; Molong, county Ashburnham; Mount Hope, county Blaxland; Copper Hill, West Bogan; Courntoundra Range, N.W. of Wilcannia; Apsley, county Vernon; Belara, county Phillip; Nymagee, county Mouramba; Thompson's Creek Mine, county Georgiana; Hurley and Wearne's Mine, near Wellington, county Wellington; and Frog's Hole, county Auckland; in the Armstrong Mine, where it contains both gold and silver; on the Manilla Creek, with grey sulphide or redruthite; Bungonia, county Argyle; Yass, county King; Peelwood, county Roxburgh, with tenorite and cerussite; Bingera, county Murchison; at Temora, county Bland, with iron pyrites, chalcopyrites, a little silver, and traces of gold.

Tenorite.—Melaconite.

Or black oxide of copper. Chem. comp. : Copper oxide = CuO; copper, 79·85; oxygen, 20·15 = 100.

Generally in the form of a black powder, massive, or sporadic, *i.e.*, disseminated in nests. Usually found associated with other oxidized copper ores, in the upper parts of veins, as at Carcoar and Milburn Creek, county Bathurst; Wellington, county Wellington; Icely; Peel-

wood, county Roxburgh; Burrowa, Gunning, Yass, and Bala, county King; Forbes, county Ashburnham; Nundle, county Hardinge; Nymagee, county Mouramba; Belara, county Phillip; South Wiseman's Creek, county Westmoreland; between Monga and the Shoalhaven, county of St. Vincent; Currawang, county Argyle; and Frog's Hole, county Auckland; at the Canoblas, county Wellington, with native gold.

MALACHITE.—Green Carbonate of Copper.

Chem comp.: Hydrous copper carbonate $= Cu_2CO_3 + H_2o$. Copper oxide, 71·9; carbonic acid, 19·9; water, $8{\cdot}2 = 100$. Metallic copper, 57·5.

Oblique system. Colour from pale emerald to deep green. Occurs massive, also mammilated and botryoidal, with fibrous concentric structure, the various layers often possessing different shades of colour, and forming a most beautiful and valuable stone for ornamental and inlaying purposes. Crystals are occasionally met with, and sometimes of large size; those from the Cobar Mines are particularly beautiful. The silky lustre is often very remarkable, the capillary crystals being sometimes several inches long, and compacted together into fibrous bundles.

It is found in most of the upper workings of New South Wales copper mines, as in the Bathurst district with chlorite, vitreous, yellow, and other copper ores; at Cambalong, earthy and fibrous malachite is associated with barytes or heavy spar, and with yellow and peacock ore; at Cobar, county Robinson, with steatite; Mitchell's Creek, Wellington, county Wellington, mixed with other surface ores, and often containing large quantities of gold and silver. Reedy Creek and Bingera, county Murchison; Icely, Yass, county King; Nymagee, county Mouramba; Buckinbah, county Gordon, in granite, with the sulphides of copper; at Lucknow, county Wellington; Gundagai, county Clarendon; Cow Flat and Milburn Creek, county Bathurst; Belara, county Phillip; Gordon Brook, county Richmond; Clarence River, county Clarence; Kaizer Mine, Mitchell's Creek, often containing beautiful specimens of coarse gold, and Peelwood, county Roxburgh; Wiseman's Creek and Oberon, county Westmoreland; Courntoundra Range, 60 miles from Wilcannia; Condobolin, county Gipps; between the Cotta and Queanbeyan Rivers, county Cowley; Mount Hope, county Blaxland. At Capabella, county Goulburn; Barraba, county Darling; Burraga, county Wellington; Silver Dale, near Bowning, county King; and Parkes, county Ashburnham, with cuprite, redruthite, and other copper minerals.

CHESSYLITE.—Azurite *or* Blue Carbonate of Copper.

Chem. comp.: Hydrous copper carbonate, $2\ CuCO_3 + CuH_2O_2$. Copper oxide, 69·2. Carbonic acid, 25·6; water, $5{\cdot}2 = 100$.

Oblique system. Colour from azure blue to indigo, translucent to opaque. Found massive and crystallized. The best specimens of the latter come from the Cobar Mines. They often assume a radiated concretionary form, with the terminal planes of the crystals studding the surface of the balls, in the form of small projections. These concretions vary from almost imperceptible points up to balls several inches in diameter; in some cases they occur diffused through a pale grey or green-coloured steatitic clay, at other times the crystals are set off by a dazzling white felspathic clay; hence they often afford very attractive cabinet specimens. Well developed crystals are also found lining vuggy cavities.

At Cobar chessylite is associated with atacamite, in addition to the other more commonly occurring minerals.

At Woolgarloo chessylite occurs with native copper, cuprite, and malachite, in pink and white fluorspar. This mixture has at times a very pretty effect from the manner in which the copper minerals are diffused through the cracks and reticulating cavities in the fluorspar. Something of the same sort of thing is to be seen in the fluorspar from South Wiseman's Creek.

Amongst other localities for chessylite are Inverell, county of Gough, in quartz-veins; Bathurst, county Bathurst; Icely; Ophir, county Wellington; and Peelwood, county Roxburgh.

Atacamite.

Chem. comp.: Hydrous oxychloride of copper = 3 $CuH_2O_2 + CuCl$. Copper oxide, 53·6; copper chloride, 30·2; water, 16·2 = 100.

Crystallizes in the Rhombic system. Dark green in colour.

Occurs in the Cobar Mines, county Robinson; Cowra, county Bathurst; and Icely.

Crystallized in radiated groups of small acicular crystals. A specimen, probably from Cobar, of a dark translucent olive green colour, with vitreous lustre and apple green streak, yielded the following result:—

Analysis.

Water lost at 105°	·536
,, combined	13·955
Copper oxide	64·709
,, chloride	13·218
Silica and insoluble matter	7·599
	100·017

Brochantite.—Blue Vitriol *or* Copper Sulphate.

Crystallizes in the doubly oblique or anorthic system, but most usually met with in the form of an efflorescence or incrustation.

Chem. Comp.: $CuSO_4$, $3CuH_2O_2$ = Copper oxide, 70·34; sulphur tri-oxide, 17·71; water 11·95 = 100.

A specimen from New South Wales gave Tschermak (Berg. Ak. Wien li, p. 131) the following results:—

Analysis.

Copper oxide	69·1
Sulphur tri-oxide	19·4
Water	11·5
	100·00

The late Mr. Stutchbury reported that at Kelloshiels the well water was found to be so impregnated with copper as to be unfit for domestic purposes. The copper was probably present as sulphate.

Dioptase.

Chem. comp.: $CuSiO_3$, H_2O = Silica, 38·1; copper oxide, 50·4; water, 11·5 = 100.

Crystallizes in the hexagonal system. Colour emerald green, with a vitreous lustre; sometimes mistaken for the emerald. This mineral is said to occur with chessylite at Cobar, in the county of Robinson.

Chrysocolla.

Chem. comp.: Hydrous copper silicate = $CuSiO_3$, $2H_2O$. Copper oxide, 45·3; silica, 34·2; water, 20·5 = 100.

Amorphous. In colour dark green. Reported to occur in a matrix of semi-opal at the Coombing Copper-mine, 2 miles from Carcoar, county Bathurst; also at Cobar, county Robinson.

A massive specimen, brought from Wheeo as a specimen of jasper, is of a bluish-green colour, much darker outside than within. Breaks with a somewhat splintery and conchoidal fracture.

Hardness = 4· Specific gravity, varied in different part from 2·37 to 2·43.

Analysis.

Water lost at 120° C.	11·92
,, ,, ,, red heat	9·40
Copper oxide (CuO)	35·28
Iron oxide	trace
Silica	43·11
Loss	·29
	100·00

As the above does not answer to the usual formula it is probable that some of the silica exists in the free state.

PHOSPHOCHALCITE.—Pseudomalachite.

Chem. comp.: Hydrous copper phosphate = $Cu_3P_2O_8,3CuH_2O_2$. Copper oxide, 70·9; phosphoric acid, 21·1; water, 8·0 = 100.

Crystallizes in the Rhombic system. Colour, dark green.

Coombing Copper Mine.

ARSENIATE OF COPPER.

Mentioned as occurring in a quartz-vein on the Cox River, but it is not stated whether the mineral was condurrite, olivenite, or one of the other arseniates.

REDRUTHITE.—Vitreous Copper Ore—Copper Glance.

Chem. comp.: Copper disulphide = Cu_2S; copper, 79·8; sulphur, 20·2 = 100.

Crystallizes in the Rhombic system. It is of a lead-grey colour, soft, and leaves a shining streak something like galena.

I have only seen this mineral in the massive state, but it is found crystallized in South Australia.

Found at Cobar, county Robinson; Mount Hope, county Blaxland; Nymagee, county Mouramba; South Wiseman's Creek, county Westmoreland; between the Lachlan and Bogan Rivers, 100 miles north-west of Forbes; Parkes, county Ashburnham; Mitchell's Creek, county Roxburgh; Bocoble; Milburn Creek, county Bathurst; Muswell, 12 miles from Goulburn, county Argyle; Cullen Bullen, county Roxburgh, with iron pyrites, copper pyrites, and calcite, containing both gold and silver; at Manilla Waters, near Bowral; near the Wellington Caves, county Wellington, with blue and green carbonates in a quartzose vein-stuff; also at Wellbank, near Wellington; at Waterfall Creek, running into Cardiangullong Creek, with iron pyrites; at Bathurst and Carcoar, county Bathurst; Kroombit and Icely.

Siliceous Redruthite.—A peculiar copper ore was received from Coombing Copper-mine, about 2 miles from Carcoar, of a dark grey, almost black colour. In general appearance somewhat resembling redruthite, but of a duller lustre, and considerably harder, the hardness being between 5 and 6. In parts a bronze tint and lustre is apparent. The specimen exhibits neither crystals nor crystalline structure; it breaks with a well marked conchoidal fracture. Lustre somewhat resinous; streak shining.

Heated in a glass tube it gives off water, having a strongly acid reaction, from the sulphurous acid which is evolved. Before the blow pipe it does not fuse, colours the flame green, and acquires a dull black colour. Treated with strong boiling nitric acid it is rapidly acted upon, a brown coloured residue being left; the residue, when examined under the microscope, presents a honey-combed appearance; the walls of the irregular cellular cavities are pale brown and translucent, and apparently composed of quartz; when the powdered mineral is boiled with nitric acid, a white residue of silica is left. Concentrated hydrochloric acid also dissolves out the copper sub-sulphide, but much more slowly.

The mineral is intimately associated with quartz, both ordinary white vein quartz, and a translucent variety of a greyish tint; this grey tint seems to be due to diffused very finely divided copper subsulphide.

The specific gravity of a portion quite free from visible quartz was found to be 3·12 at 18° C.

The following analysis was made upon a portion which appeared to be perfectly homogeneous even under a 1-inch objective; yet this yielded over 43 per cent. of silica.

Analysis.

Water, combined	2·354
Silica	43·420
Copper subsulphide (Cu_2S)	45·196
Iron sulphide (Fe S)	4·931
Iron sesquioxide	3·479
Undetermined and loss	·620
	100·000

The combined water was determined directly by collecting and weighing it in a chloride of calcium tube, a layer of lead oxide being placed in the front part of the combustion tube to arrest any sulphur or sulphur oxides.

The amount of silica soluble in a boiling solution of sodium carbonate, was also determined, and found to vary from 14·69 to 19·99 per cent.

The mineral therefore appears to be merely an intimate mixture of hydrated amorphous, and crystalline quartz, copper subsulphide with some iron oxide and ferrous sulphide.

Bornite.—Erubescite.

Purple Ore. Buntkupfererz.

Chem. comp.: varies considerably. A double sulphide of copper and iron. Copper, 56 to 70; iron, 6 to 17; sulphur, 21 to 26. Crystallizes in the cubical system. Colour, copper-red, purple to brown; fracture, even to small conchoidal; streak, blackish grey, shining.

Found at Cobar, county Robinson; Bingera, county Murchison; Wellbank and Louisa Creek, county Wellington; and Cow Flat, county Bathurst.

Fahlerz.—Grey Copper Ore. Tetrahedrite.

Chem. comp.: $4\ Cu_2S + Sb_2S_3$, but variable. Part of the copper often replaced by iron, zinc, silver, mercury, or cobalt; and the antimony partly replaced by arsenic and occasionally by bismuth. At times it is very rich in silver, even as much as 30 per cent. Crystallizes in the cubical system, usually in tetrahedral forms—hence one of its synonyms; colour, grey; soft, cuts with shining streak.

Occurs on the west side of Copper Hill, near Molong.

Chalcopyrites.—Copper Pyrites.

Chem. comp.: Copper-iron sulphide Cu_2S,Fe_2S_3, but variable. Copper, 34·6; iron, 30·5; sulphur, 34·9 = 100. Tetragonal system; hemihedral forms. A very abundant ore. Usually occurs massive; occasionally crystals are met with, but they are generally but imperfectly developed. Colour, usually brass yellow. Blister ore is more of a bronze colour, and occurs in mammillated and botryoidal forms. The tarnished variety of copper pyrites, known as peacock ore from the splendid colours which it acquires, is very common.

It occurs in nearly all the metalliferous districts in the Colony, at Cobar, county Robinson; Bingera, Elsmore, county Murchison; Clarence, county Clarence; Wiseman's Creek and Oberon, county Westmoreland; Wellington District; with zinc blende, steatite, quartz, and asbestos; Ophir, Carcoar, Cow Flat, and Mitchell's Creek, county Bathurst; Wallabadah, county Buckland; Cargo and Molong, county Ashburnham; Peelwood, county Roxburgh; Tuena, Charlton, Essington, county Georgiana; Adelong with gold, county Wynyard; Lobb's Hole and Yarrangobilly, county Buccleugh; Kiandra, county Wallace; Gordon Brook, county Richmond; Snowball Mine, near Gundagai, county Clarendon; Dundee, county Gough; Goodrich and Narragal, county Gordon; Cootalantra Mine and Belmore Mine, Monaro district; between Condobolin and Parkes; Frog's Hole, county Auckland; Nymagee, county Mouramba; Solferino, county Drake; Apsley, county Vernon; Bungonia and Currowang, Jacqua Mine and Nerrimunga, county Argyle; and Mallone Creek, between Goulburn and Braidwood.

Bell-metal Ore.—Cobar, county Robinson.

Domeykite.

Chem. comp.: Copper arsenide, Cu_3As. Copper, 71·7; arsenic, 38·3 = 100. Amorphous. Occurs in the Bathurst district with yellow sulphide of copper.

Antimonial Copper Ore.

Said to occur at Eden, Twofold Bay, county Auckland.

Dioptase, olivenite, liebethenite, bournonite, and other beautiful copper minerals, have not apparently yet been found.

Return showing the Quantity and Value of Copper produced in the Colony of New South Wales.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	tons	£		tons	£
1858	58 ore	1,400	1869	2,084	76,675
1859	150 ,,	2,250	1870	1,000	65,731
1860	43 ,,	1,535	1871	1,444	88,886
1861	144 ,,	3,390	1872	1,452	105,888
1862	2,200 ,,	12,000	1873	2,846	239,102
1863	125 copper	12,500	1874	4,160	325,140
1864	2,100 ore	22,100	1875	3,677	301,690
1865	295 copper	37,345	1876	3,275	249,978
	1,648 ore		1877	4,513	324,226
1866	304 copper	28,135	1878	5,219	345,158
	947 ore		1879	4,142	257,352
1867	296 copper	35,316	1880	5,394	364,059
	2,590 ore		1881	5,361	355,062
1868	315 copper	34,200	Total		3,213,558
	5,151 ore				

Lead.

Native Lead.

The Rev. W. B. Clarke more than once mentions having found native lead, on the Peel River, Hanging Rock, and elsewhere.

It has also been found by the miners on the gold-fields, in association with serpentine, on the spurs of the Curangora, near Bingera, county Murchison. One specimen had a specific gravity of 11·04.

In 1880 I received an irregular piece of native lead from a miner, about $1\frac{1}{2}$ inch long by 1 inch wide, and about $\frac{1}{8}$ to $\frac{3}{16}$ of an inch thick, with rough surface, as if it had filled a jagged crevice, coated on the outside with impure oxide of lead of a brilliant red colour. The edges were slightly rounded as if water-worn. It did not look at all as if it had been reduced artificially or had been derived from bullets or sources of that kind. Weight = 32 grammes. Found near Gundagai.

The majority of the specimens of native lead which have been brought to me from time to time have usually been derived from bullets, which have found their way into the river deposits, and have been found by the miners when washing for gold.

Minium—Native Red Lead.

Chem. comp.: Lead oxide = Pb_3O_4. Lead, 90·66; oxygen, 9·34 = 100. Occurs with cerussite at Peelwood, near Tuena; and near Gundagai.

Cerussite.

Chem. comp.: Lead carbonate = $PbCO_3$. Lead oxide, 83·5; carbonic acid, 16·5 = 100. Occurs massive and in large prismatic crystals at Peelwood Mine; on the exterior they are often coloured red by a ferruginous clay. Also found at Tuena in a red clay; at Solferino; at Silverdale, near Bowning, with other lead ores and fluor spar.

Anglesite.

Chem. comp.: Lead sulphate = $PbSO_4$. Lead oxide, 73·6; sulphuric acid, 26·4 = 100. Said to have been found with galena on the Abercrombie River.

Pyromorphite.

Chem. comp. : Lead phosphate = $3Pb_3P_2O_8$, PbCl. In round numbers, lead oxide, 75·0; phosphoric oxide, 15·0; lead chloride, 10 = 100. Small quantities of calcium fluoride and calcium phosphate are usually present, and part of the phosphoric acid is at times replaced by arsenic acid.

Hexagonal system; usually in six-sided prisms.

At Grenfell, it is found as a bright green-coloured powder containing minute hexagonal prisms; it is also found of the same colour associated with galena and mimetite in a vein traversing clay slate, near Bathurst. Another specimen from Bathurst was of a pale greyish-brown colour, with a waxy lustre, and mammillated surface, upon which small crystals of chessylite were seated.

It occurs on the Sugar-loaf Hill, near Wellington; also on Mitchell's Creek; and at Silverdale, near Bowning, with galena.

Mimetite.—Kampylite.

Chem. comp. : Lead arseniate = $3Pb_3As_2O_8$,PbCl. In this mineral the phosphoric is replaced by arsenic acid. Of a brown colour, and in much-curved or barrel-shaped hexagonal prisms. With pyromorphite at Sugar-loaf Hill, Wellington; Mitchell's Creek and Gulgong.

Wulfenite.

Chem. comp.: Lead molybdate = $PbMoO_4$. Lead oxide, 61·5; molybdic acid, 38·5 = 100. Mentioned as occurring on a spur of Mount Murulla, Kingdon's Ponds, and near Mount Wingen, county Brisbane. The Rev. W. B. Clarke also records finding drifted molybdate of lead, water worn and with a radiate structure, on the North Shore; at Molongo, in the county of Murray; and at Munmurra, county Bligh.—*Sydney Morning Herald*, August 17, 1850.

Galena.

Chem. comp.: Lead sulphide = PbS. Lead, 86·6; sulphur, 13·4 = 100. This, as elsewhere, is the commonest ore of lead; it not only occurs in large deposits, but it is widely distributed over the Colony.

It is usually found in the massive state, and with a granular structure which varies from fine to coarse. Occasionally it is met with fairly well crystallized, usually in cubes and in combinations of the cube and octohedron, as at Cambalong, but on the whole crystals are rare. In other respects it presents all the usual properties of the mineral as found in other countries.

Localities.—Argentiferous galena on the Chichester River; near Inverell, and other places in New England; in the county of St. Vincent, on the Talwal, Yalwal and Major's Creeks, and near Braidwood; county of Murchison, at Reedy Creek; county of Buckland, at Wallabadah; at Menindie, in the county of Menindie; in the county of Parry, on the Peel River, and at Mount Grosvenor; in the county of Brisbane, on the Page, Isis, and Hunter Rivers; in the county of King, at Burrowa, in quartz veins, at Silverdale, Pudmore Creek and the Good Hope Mine, near Yass; in the county of Phillip, at Lawson's Creek, with copper ores, and Gulgong; the county of Harden, at Jugiong Creek and Mylora Creek, in a quartz porphry, Murrumburrah and Bookham; county of Monteagle, at Crookwell, and the Garibaldi Reef, near Young; county of Bathurst, at Waroo, Humewood, Cow Flat Copper-mine, with carbonate and sulphide of copper; at Eurongilly, county Wynyard; county of Wellington, at Wellington and Ophir, county Roxburgh, Mitchell's Creek, in quartz with sulphides of copper and iron, and blue and green carbonates of copper; county of Hardinge, at Sandy Swamp and Tingha; county of Clarendon, at Bethungra, and the Sebastopol Reef, Junee; at Woolgarloo, in association with fluor spar; in the county of Wellesley, near Bombala; at Kiandra, in the county of Wallace, in quartz veins; at Quedong, Monaro District; Wiseman's Creek, county of Westmoreland; Canberra Plains, county of Murray; in the county of Argyle, near Goulburn, and at Bungonia; in the county of Roxburgh, at Peelwood; Ravenswood; in the county of Cook, near Hartley; Port Denison; at Merimbula, county of Auckland; Burragorang; in the county of Gough, at Glen Innes, Inverell; at Moruya, in the county of Dampier; on the Shoalhaven; Umberumba Creek, county of Yancowinna; at Kempsey, county of Dudley; and in the county of Drake, at Solferino.

In all cases the galena contains more or less silver.

Return showing the quantity and value of Lead produced in the Colony of New South Wales *(Annual Report of the Department of Mines, Sydney)* :—

Year.	Quantity. Tons.	Cwts.	Value. £
1876	67	0	1,392 *
1877	20	12	325
1878	5	0	258
1879	18	13	535
1880	27	14	890
1881	52	14	1,625
Total	191	13	5,025

Cadmium.

A specimen of greenockite, the very rare cadmium sulphide, is said to have been found on Louisa Creek associated with zinc blende and quartz.

Bismuth.

Native Bismuth.

Metallic bismuth occurs associated with carbonate of bismuth, oxide and sulphide, of molybdenum and gold in a quartz-vein near Tenterfield, county of Clive, on analysis this gave the following result :—Bismuth, 60·09 per cent. ; gold, 1 oz. 4 dwts. 10 grs. ; silver, 0 oz. 8 dwts. 10 grs. per ton. Found in lumps near Byrne's Lode, in the same county. An earthy form of bismuthite from Tenterfield was also found by Mr. Dixon to yield : Bismuth = 43·29 per cent., and molybdenum sulphide, 6·60.

Occurs with copper ores at Cobar, county Robinson, as shown in the following analyses by Mr. W. A. Dixon (*Report of the Mining Department*, Sydney, 1880) :—

Analyses.

	No. 1.	No. 2.	No. 3.
Silica	4·26	1·92	·96
Copper	22·84	54·93	26·47
Antimony	·61	traces	·46
Bismuth	2·11	2·58	2·17
Lead	·27	......	......
Arsenic	traces	......	......
Iron	39·20	18·26	39·09
Zinc	·35	......	......
Silver	traces	......	......
Sulphur	24·11	14·48	27·46
Oxygen water, loss & undetermined	6·25	7·83	3·39
	100·00	100·00	100·00

Calculated into proximate constituents, these results give :—

	No. 1.	No. 2.	No. 3.
Silica	4·26	1·92	·96
Cuprous sulphide	28·60	26·09	33·14
Ferric ,,	37·44	68·73	43·35
Antimony	·85	......	·64
Bismuth	2·59	3·16	2·66
Lead	·31	......	......
Zinc	·52	......	......
Feroso ferric oxide	24·50	......	18·82
Traces, arsenic, silver, water and loss	·93	·10	·43
	100·00	100·00	100·00

* These figures represent the quantity raised during 1876 and previous years.

Localities.—In the New England District, at the Bruce Mine; county of Gough, near Glen Innes, at Redgate, on the Silent Grove Creek, where a vein averaging 8 inches wide was being worked in 1880; at the Elsmore Mine, also being worked, and Kingsgate, 18 miles east of Glen Innes, where a lode 6 to 8 feet wide was reported as being worked in 1880; in the county of Sandon, at Armidale; in the Vegetable Creek District, at the Gulf and on Duck Creek; a lode is stated to have been found near Kempsey, in the Macleay District.

Bismuthite.

Chem. comp.: A hydrated carbonate of bismuth. Bismuth oxide, 90·0; carbonic acid, 6·5; water, 3·5 = 100.

Found in the form of more or less rounded grains and pebbles with stream tin in the New England District.

Samples of bismuthite from Tingha, county of Harding, in the form of white and dark brown water-worn nodules were found to contain 60·43 per cent. of bismuth; another with talc and sesquioxide of iron, 62·75 per cent. of bismuth.

Generally found in the form of dull grey or white earthy-looking rolled fragments—usually about the size of a pea, but sometimes larger pieces are found. Breaks with a dull earthy fracture. Found with the stream tin over most parts of the New England Tin District. A specimen from Ponds Creek gave the following results:—

Hardness = 3 to 4.

Analysis.

Silica	4·695
Bismuth trioxide (Bi_2O_3)	76·061
Alumina and traces of iron sesquioxide	1·983
Carbonic acid	5·426
Water, by difference	11·835
	100·000

The above does not agree with the usual formula given for this mineral. The specimen is more or less impure, as is shown by the presence of the silica, alumina, and iron.

Tellurium.

Native Tellurium.

A rare metal; reported to occur at Bingera, county Murchison.

Molybdenum.

Molybdenite.

Chem. comp.: Molybdenum sulphide MoS_2. Usually found massive, with a coarsely granular structure; also in grains, scales, plates, and rosette clusters of crystals. Sometimes the flat hexagonal plates or crystals are of large size; I have found some as large as a half-crown on the Elsmore Tin-mine, county Gough.

The colour is usually bluish-white, with a strong metallic lustre.

Associations.—It is rather common in the New England Tin Districts, especially at the Elsmore and Newstead tin-mines, where it occurs in the tin veins traversing the granite. It is most usually associated with quartz. On the Hunter River it is found associated with gold, galena, pyrites, and other minerals.

Localities.—It also occurs at Bullin Flat, near Goulburn, county Argyle; at Kiandra, county Wallace, with quartz; and Cleveland Bay; Oban; Goodcrich Mine, county Gordon; near Kempsey, county Dudley; also at Kingsgate, near Glen Innes, county Gough.

Arsenic.

Native Arsenic.

In massive pieces with mammillated surfaces, Lunatic Reef, Solferino, county Drake, with mispickel; Winterton's Mine, Mitchell's Creek, with gold and silver; Louisa Creek, county Wellington.

Mispickel.—Arsenical Pyrites.

Chem. comp.: Sulp-arsenide of iron $FeS + FeAs$. Arsenic, 46·0; sulphur, 19·6; iron, 34·4 = 100.

Rhombic system. Colour almost silver white. Streak dark-greyish black.

Rather large crystals occur with quartz near Goulburn, also on the Shoalhaven River associated with small hexagonal prisms of beryl, which penetrate the mispickel; in New England, Elsmore, and other places; large well-formed crystals of mispickel on Louisa Creek; also on Back Creek, Barrington, county of Gloucester, with gold; and at Dundee and Wattle Flat; near Orange, very rich in gold; on the Moama or Mitchell River, near Cooradooral; Marulan, county Argyle; Moruya, county St. Vincent, with blende and galena, and containing a fair proportion of gold and silver; at Carcoar, county Bathurst, with marcasite and common pyrites; Gulgong, county Phillip. Auriferous mispickel with iron pyrites, in grey steatite, and with talc, at Peelwood, county Roxburgh.

At Ournie, payable quantities of gold and silver occur in mispickel. Occasionally the mispickel is exceedingly rich in gold, as at Lucknow.

Löllingite.—Leucopyrites.

Chem. comp.: Iron arsenide = $FeAs_2$; arsenic, 72·8; iron, 27·2.

Louisa Creek, county of Wellington, and near Gundagai, in small but well formed crystals.

Realgar.

Chem. comp.: Arsenic sulphide AsS; As. 70·1, S. 29·9 = 100.

Oblique system. Orange red, translucent. Louisa Creek, county Wellington.

Pharmacolite.

Chem. comp.: A hydrated calcium arseniate, H_2CaAsO_4, 5 H_2O.

On Louisa Creek. In large imperfect crystals, dark-grey colour, coated with white and yellow incrustations in part.

Antimony.

Native Antimony.

I can find no authentic record of the occurrence of native metallic antimony in New South Wales, although I believe it has been met with in New England and elsewhere.

Antimonite—Stibnite—Antimony Glance.

Chem. comp.: Antimony sulphide = Sb_2S_3; $Sb = 71·8$; $S = 28·2 = 100$.

This ore is met with in the massive state in mineral veins, and occasionally in rolled masses; well formed crystals appear to be rare.

At times the cleavage planes are particularly large and brilliant, at others the structure is more compact and granular.

It occurs on the Clarence and Paterson Rivers, the mineral is found in masses of large size, and showing broad, well-defined, striated cleavage planes, portions of the surface usually being incrusted with a yellow coating of cervantite, an oxide of antimony = SbO_4.

A specimen of antimonite from Pyramul, county Wellington. In splendid massive blocks, showing well-developed striated cleavage planes. Exterior coated with the yellow coloured oxide of antimony (SbO_4) gave

Metallic antimony	67·74
Gold	traces
Silver	traces

A minutely crystalline stibnite, with a little oxide, and traces only of iron and lead, contained—antimony, 56·41 per cent.; gold and silver, 19 grains per ton. This sample was from near Uralla, county of Sandon, and the precious metals consisted chiefly of gold.

A specimen of antimonite from Munga Creek, about 4 miles above its junction with the Macleay River, in rocks apparently of Devonian age, yielded Mr. Dixon 2 dwts. 10 grains of gold per ton, and traces of silver.

The veins vary in width from 4 inches to 25, 30, and 49 inches; the vein-stuff is principally quartz, in which the antimonite and associated cervantite occur in irregular masses, some of the blocks being of considerable size.

It is found associated in many parts of New England with tin-stone, molybdenite, wolfram, and other minerals.

Localities.—Tenterfield, county of Clive; in the county of Sandon, at Armidale, Gara, Uralla, and Dangar's Falls; at Gresford, county Durham; in the county of Roxburgh, at Rylestone, Sofala, Peelwood, and Palmer's, on the Upper Turon; at Bingera, in the county of Murchison; on the Rocky River, county Hardinge; at Grafton, in the county of Clarence; in the Macleay and Hastings Districts; near Mount Mitchell, in the county of Clarke; at Boorolong; South River Range; in the county of Drake, at Solferino, Drake, and Washpool Creek; at Nundle, county Parry, where the reef of antimonite runs north and south, with a dip to the west—the width at surface is about 15 inches; Wallerawang, county Cook; Gundagai, county Clarendon; Bungonia, county Argyle; Shoalhaven, county St. Vincent; Eden, county Auckland; Coolongolook and Caragula, in the Macleay District; Crudine Creek, near Bathurst; Gineroi, north-west of Bingera; Lunatic, county Drake; on the Peel River, 12 miles north of Hanging Rock; at Yugilbah Station; Sharpening-stone Creek, near Yass; Warril, north of Kempsey; Hermine; 12 miles from Uralla; 18 miles north-west of Gobandry and Wiseman's Creek; at Hargrave's Falls, county Wellington; at Aberfoil, county Clarke.

The Rev. W. B. Clarke records finding a rolled mass of 3 lbs. weight in the superficial ironstone gravel on an unfrequented hill on the north shore of Sydney Harbour.

Cervantite.

Chem. comp.: Antimony oxide $= SbO_4$, Sb, 79·2; O, 20.8 = 100.

Usually occurs massive, as an incrustation upon antimonite, sometimes as minute acicular crystals of a dull yellow colour.

Localities.—Almost the same as those for antimonite, as at Gara near Armidale, county Sandon; Pyramul, county Wellington; and other places.

Jamesonite.

Chem. comp. $= 2\ (PbFe)\ S + Sb_2\ S_3$; sulphur, 21·1; antimony, 32·2; lead, 43·7; iron, 3·0 = 100.

This mineral usually occurs in fibrous masses of a bluish lead-grey colour.

It occurs with cervantite in a soft quartz near to Campbell Creek and Nuggety Gully, Bathurst District.

Return showing the quantity and value of antimony produced in the Colony of New South Wales *(Annual Report of the Mining Department, Sydney)*:—

Year.	Quantity. Tons.	cwt.	Value. £
1871	31	0	560
1872	0	13	5
1873	27	12	210
1874	12	15	122
1875	142	0	5,000
1876	40	0	140
1877	69	12	1,131
1878	64	0	1,964
1879	76	16	1,046
1880	99	19	1,652
1881	539	24	17,346
Total	1,104	11	29,176

There were no returns previous to 1871.

Tin.

Cassiterite.—Tin-stone.

Chem. comp.: Tin binoxide $= SnO_2$. Tin, 78·67; oxygen, $21{\cdot}33 = 100$.

Tetragonal system. Occurs massive, crystallized, and as rolled pebbles and masses known as "stream tin." Well-developed crystals are by no means rare; the forms assumed are very similar to those found in other countries, viz., the prism, or a series of prisms combined with the pyramid, or pyramids, with and without the basal pinacoid plane. Sometimes the crystals are very large, especially those which are made up solely of the planes of the pyramid.

The lustre is usually bright metallic, and many of the specimens are very beautiful, especially some of the ruby and amber coloured transparent specimens, which, however, have not as a rule so high a lustre as the black crystals; the colour varies from almost colourless and transparent, through shades of grey, yellow, amber, red, brown, to black and opaque. Often more than one of these colours are to be seen in the same specimen, when the effect is very fine, especially the admixture of the ruby-red and translucent amber colours.

The hardness and specific gravity do not appear to materially differ from tin-stone obtained elsewhere. Specimens having a specific gravity of only 4·463 and 5·413 have been met with, but they are probably very impure, although fairly well crystallized.

Discovery of Tin-stone.—The probable presence of tin in Australia was mentioned as early as January, 1799. Collins, in his account of the English Colony in New South Wales, states that Mr. Bass, the surgeon of H.M.S. "Reliance," found on the beach of Preservation Island (on the north coast of Tasmania, near the south coast of Barren Island) "a very considerable quantity of the black metallic particles, which appear in the granite as black shining specks, and are in all probability grains of tin." Tin-stone or cassiterite is commonly known simply as tin by Cornish miners and others.

Mr. Bass is not likely to have mistaken grains of black mica, hornblende, or other minerals for tin-stone, since he appears to have possessed considerable geological knowledge, and moreover had he done so he would probably have "discovered" tin in other places where granite exists.

Prior to about 1872 the alluvial tin-stone met with by gold-diggers was thrown aside as a valueless black sand; after its value was recognised by some Cornish miners a rush for tin-mining set in.

A miner, named James Daw, claims to have discovered tin on the Broadwater, a tributary of the Severn River, then in the colony of New South Wales, now Queensland, in the beginning of 1849.

The first public mention made of the occurrence of tin in New South Wales was by the Rev. W. B. Clarke. In the *Sydney Morning Herald*, August 16th, 1849, he records having found it in the Alps along part of the Murrumbidgee.

The Rev. W. B. Clarke also found small quantities of tin in the New England District, and drew attention to the same in his report dated 7th May, 1853.

In the *Papers Relating to Geological Surveys* published by the Government, I find that Mr. Hargraves makes the following mention of tin ore in New South Wales:—

P. 71. "Guntawang, 18th July, 1851.

"I have received information from Mr. Rouse of this place (Guntawang) that a shepherd of his found tin at Warranbungall Mountain some years ago, distant 100 miles north of this place. I have therefore determined to visit the locality, and start for that place to-morrow, &c.—E. H. Hargraves."

P. 72. "Mudgee, 3rd August, 1851.

"In travelling 6 miles N.W. of the Cudgegong, I found the gold region ceased; and on arriving at the Warranbungall Mountains, 100 miles N.W., I found coal and iron in great abundance on every hill, but was not successful in finding the tin. The shepherd who knows the locality gave me a piece which he had smelted into bars, a sample of which I herewith enclose, which I should suppose contains 30 per cent. of silver *(sic.)*, and in a short time the locality will be known to me. The man wants a large consideration for disclosing the whereabouts at present.—E. H. Hargraves."

The principal tin veins in New South Wales which have yet been worked occur in granite at once seen to be similar to that of Cornwall. In some parts, as at Elsmore and Newstead, county Gough, New England, much of it occurs in veins of greisen (mica and quartz), and in eurite (felspar and quartz). At Newstead Mine, and also at the Albion Tin-mine, crystals of

tin-stone are seen disseminated through large and well-formed transparent quartz crystals. At the former place the quartz crystals in which it occurs often weigh nearly a hundredweight. A vein of tin-stone 1 inch thick was being worked near Bungonia in 1870.

Mr. Clarke mentions having found tin-stone pseudomorphous after felspar crystals in New England, corresponding to those from St. Agnes Mine, Cornwall.

Tin-stone occurs in association with quartz, mica, orthoclase felspar, molybdenite, fluor spar, usually of pale shades of purple and green, a yellow steatitic mineral, garnet, beryl, topaz, the matrix of the tin-stone is sometimes in places composed solely of topaz; malachite, copper and iron pyrites, mispickel, tourmaline or schorl; with garnets, wolfram, and radiated groups of schorl crystals at Giant's Den, Bendemeer. I have not seen wolfram in the same veins, but in other veins almost in juxtaposition. It is interesting to note that nearly all the minerals found associated with tin-stone in Cornwall, Germany, France, America, and elsewhere have been met with this mineral in New South Wales.*

Tin *lodes* or veins occur at Mowembah, in the Maneero District; in the Inverell District; Mole Table land; the Gulf; the Grampian District; rich lodes are said to exist at Rose Valley, Silent Grove, about 30 miles to the N.E. of Vegetable Creek; near Eremeran, in granite, county of Blaxland. Vein tin is also reported to occur in quarries at Billabong, near Wagga Wagga.

Wood tin occurs in veins at Glen Creek, county Gough.

Alluvial tin deposits.—There are two distinct sets of tin drifts, an older and newer; the former are generally much more compact and are often cemented together into a hard conglomerate, usually so hard as to require stamping. The tin-stone is also much rounded and water-worn; whereas the tin-stone in the newer drift is bright, and has undergone but little attrition. Some of the fragments or pebbles of rolled tin-stone weigh many pounds, notably on the Butchart Tin-mine.

A specimen of dark-coloured, almost black stream tin-stone from the Jupiter Mine, Vegetable Creek, county Gough, New England, gave the following results:—

Analysis.

Stannic oxide (SnO_2)	89·92
Titanic acid (TiO_2)	·69
Alumina	6·75
Silica	·80
Iron sesquioxide	2·30
	100·46

Specific gravity, 6·629.

The minerals found associated with the stream tin are much the same as those found with it *in situ*; but in addition we find gold in small quantities, diamonds, sapphire, zircon, pleonaste, topaz often of large size, bismuthite, rutile, and other minerals of high specific gravity.

Rolled *wood tin* of a grey and black colour, at Abingdon; also at Grenfell and Lambing Flat, county Monteagle, with extremely well-marked concentric and radiate structure, composed of red, brown, and black bands, other fragments are made up of alternate light and dark-grey bands; with diamonds near Mudgee and Bathurst; at Tumberumba, 10 or 12 miles from Kiandra, with gold, in the granite. The variety known as Toad's-eye tin is also met with here and on the Grampian Hills.

Localities.—In the county of Hardinge, at Bundarra; the Severn; Paradise, Swan, Auburn Vale, Cope's, Sandy, Moredun, Honey's, and Honeysuckle Creeks, and Kentucky Ponds; at Fairfield and Lunatic; in the county of Murchison, at Bingera, the Gwydir River, Rocky River, and the Myall, Reedy, and Bald Rock Creeks; in the county of Wallace, at Adaminaby; in the county of Buller, at Undercliff, Bookookoorara, and in the Maryland, Herding, and Boonoo Boonoo Creeks; at Tea Tree Creek, in the county of Clarence; in the county of Gresham, on the Mitchell, Henry, and Ann Rivers; on Gordon's Creek, in the county of Richmond; in the county of Gough, at Ranger's Valley, on the Severn, Macintyre, and Yarrow Rivers, Stockyard,

* See Etudes synthétiques de Géologie Expérimentale, Prof. A. Daubrée, p. 30, *et seq.* Paris, 1879.

Glen, and Middle Creeks; at Kingsgate; in the county of Darling, on the Mangahra, Tiabundie and Mount Lowry Creeks; in the county of Clarke at Mount Mitchell and Oban and the Sara River; the Warialda Creek, county of Burnett; in the county of Roxburg, at Sheep Station Creek, and Turon River; at Spring Creek, county Wellington; at Uralla, county Sandon; in the county of Inglis, on Carlyle Creek, and Bendemeer, in greisen; in the county of Clive, at Deepwater, Mole River and Sandymount; in the county of Buckland, at Quirindi and Carroll's Creek; on the Shoalhaven, county St. Vincent; at Long Gully and Spring Creek, county Argyle; at Burra Creek, county Selwyn; Dabarra, county Buccleuch; Jingellic Creek, county Goulburn; Pullitop Creek, county Mitchell; Mowembah, in quartz associated with chalcedony, and at Blair Hill, Yarra Creek. Alluvial tin deposits, covered by 60 or 70 feet of basalt, are worked in Swinton parish, county of Hardinge.

Grey stream tin found at Manners Creek, Tumberumba, near Kiandra, and at Attunga, near Albury; it is also said to occur in the belt of dry country between the Lachlan and Bogan Rivers, commencing at about 100 miles N.W. of Forbes. The same district is said to be rich in gold, copper, and iron; at Boona West, county Blaxland, and Jumble Plains.

The stanniferous area in New South Wales estimated at $5\frac{1}{2}$ millions acres, or 8,500 square miles.

Up to the present, most of the tin has been obtained from the New England District.

Return showing the quantity and value of tin produced in the Colony of New South Wales *(Annual Report of the Mining Department, Sydney)*:—

Year.	Quantity. Tons.	Value. £
1872	896	47,703
1873	4,571	334,436
1874	6,219	484,322
1875	8,080	561,311
1876	6,958	439,638
1877	8,054	508,540
1878	7,210	395,822
1879	5,921	372,349
1880	6,159	471,337
1881	8,200	724,003
Total	62,268	4,339,461

Titanium.

Rutile.

Chem. comp.: Titanic acid = TiO_2. Crystallizes in the tetragonal system, usually in prisms. Up to the present time I have only found it in the form of fragments of crystals with striated surfaces, or in rounded grains of a hair-brown colour. It is found with the gem sand at Bald Hill near Bathurst and at Uralla.

Brookite.—Which is an allotropic form of titanic acid, crystallizing in flattened forms belonging to the rhombic system, has also been found in New South Wales, at Burrandong, in water-worn, imperfectly crystallized, striated plates, of a dark red-brown colour, with metallic lustre, but of a bright red colour by transmitted light.

In the diamond drift near Mudgee as flat, transparent, red and translucent reddish-white plates, with striated surfaces. $H = 6$, and sp. gr. = 4·13. Chem. comp.: pure titanic acid, except a minute trace of iron oxide.—Dr. A. M. Thompson, Jour. Royal Society of N.S.W., 1870, p. 102.

Anatase.—A third allotropic form of titanic acid, crystallizing in tetragonal pyramids. This has been found at the dry diggings of Burrandong. Some fairly good crystallized specimens have been found in the Cudgegong River, county Phillip.

Sphene.

A calcium silico-titanate. I have met with but one well crystallized specimen, of a green colour; the locality in New South Wales from which it came is uncertain.

Tungsten.

Wolfram.

Chem. comp. : Iron and Manganese tungstate = $(FeMn)WO_4$. It is found in rolled masses in association with tinstone in many parts of New England. It is also found *in situ* in the quartz veins on Elsmore and Newstead Mines, on Glen Creek, county Gough, and other places, in the usual form of imperfectly developed tabular crystals. It is commonly accompanied by iron pyrites.

A specimen found in quartz veins with tinstone, Inverell, county Gough, of the usual bronzy-black colour; sub-metallic lustre; opaque; lamellar structure, with only traces of crystal faces, had the following composition:—

Analysis.

Tungstic acid	77·640
Iron protoxide	18·760
Manganese	4·121
	100·521

Scheelite.

Calcium tungstate = $CaWO_4$. Crystallizes in the pyramidal system. Occurs in New England and at Adelong.

A specimen from the Victoria Reef Gold mine, Adelong, county Wynyard, was massive, but with a portion of a crystal showing on one side, of an amber colour, translucent, resinous lustre, brittle, splintery fracture.

Hardness, 4–5; specific gravity, 6·097. Associated with a dark-green chloritic vein stuff.

The following analysis was kindly made for me by Dr. Helms:—

Analysis.

Loss at red heat	·25
Tungstic acid	79·53
Lime	19·14
Alumina	·58
Magnesia	·07
	99·57

The above results correspond to the formula $CaWO_4$.

Iron.

Native Iron.

Out of a large number of specimens of so called native iron which have come before me from time to time, not one was entitled to be so-called; they had all without exception been derived from iron or steel tools.

Native iron, apart from that derived from meteorites, however, probably does occur in the Colony, and it is most likely to be found in or near to igneous rocks, *e.g.*, melted globules of native iron have been met with at Ballarat in Victoria in connection with basalt.

Magnetite.—Magnetic Iron Ore.

Chem. comp. : Iron Oxide = Fe_3O_4. Iron, 72·4; oxygen, 27·6 = 100. Cubical system.

This is the richest of all the ores of iron, and when perfectly pure it only contains rather more than 72 per cent. of metallic iron; hence the absurdity of the statement so commonly made by the promoters of Mining Companies that the iron ores on a certain property contain over 90 per cent. of metal will be at once apparent; and, moreover, it is a very rare thing indeed for large masses of any ore to be quite pure, therefore, instead of the amount of metal in the vaunted mineral even approaching to the alleged richness it falls far below it, and most probably it is much nearer to 40 than to 90 per cent.

It is found in the Colony both massive and crystallized in octohedra, which are usually small. In structure it varies, being compact, granular, or lamellar.

Large deposits of magnetite exist at Wallerawang, county Cook; Mount Lambie, with micaceous hæmatite, in a chloritic matrix; Mount Wingen, county Brisbane; Solferino, county Drake, in quartz veins; Grafton, with copper ores; on the Clarence and the Shoalhaven Rivers.

The following extracts are from a paper read before the Royal Society of New South Wales :—

"The deposits of iron ore at present opened out are situated some 6 miles from Wallerawang, and near the junction of the coal measures with the Upper Silurian or Devonian beds, which there crop out to the surface. These deposits contain two varieties of iron ore, viz.—magnetite or the magnetic oxide of iron, and brown hæmatite or goethite—the hydrated oxide; then in addition to these there are deposits of the so-called "clay band," which are interstratified with the coal measures. These clay bands are not what are usually known as clay iron ores in England. They are brown hæmatites, or limonite, while the English clay iron ores are impure carbonates of iron, which seldom contain much more than 30 per cent. metallic iron, against some 50 per cent. contained by these hæmatites.

"A highly ferruginous variety of garnet accompanies the veins of magnetite; this garnet is very rich in iron, and it will probably be found advantageous to smelt it with the other ores, not only on account of the large percentage of metal which it contains, but also on account of the increased fluidity which it would impart to the slag."

"*Magnetite.*—The vein of magnetic iron ore runs apparently N.E. by S.W. This can only be stated approximately, for, owing to the action exercised by it on the needle, the compass was found to be perfectly useless in the vicinity of the lode.

"The ore is scattered over the ground in blocks and nodules along its outcrop; but at a little depth it is in a solid and compact body, merely broken across here and there into large masses by joints and fissures.

"In one part the vein has a width of thirteen (13) feet; but at another spot, where a trench was cut across, it was there found to be not less than 24 feet in width.

"Two shafts have been sunk on this vein—one to a depth of 10 and the other to a depth of 23 feet. At these depths the quality of the ore is about the same as that at the surface; but certain portions of the vein are evidently richer than others.

"At present the average yield of metallic iron from the vein, as a whole, is not rich for a magnetite, which, when perfectly pure, contains 72·41 per cent. of iron, and under ordinary circumstances about 70 per cent., whereas the Wallerawang vein yields only 40·89 per cent.

* * * * * * * * *

"This average was obtained by taking samples from different parts, across the whole width of the trench cut across the vein, and then crushing them all up together. As I have before mentioned, picked portions yield a much larger percentage.

"On the whole, taking all the circumstances into consideration, we may come to the conclusion that the true capabilities of the deposit of magnetite have not yet been fully tested or proved.

"The vein stuff or gangue accompanying the magnetic iron ore is silicious. In some parts of the lode this appears to be replaced by the ferruginous garnet rock.

"A partial analysis this ore yielded the following results :—

Silica and insoluble matter	18·70 per cent.
Metallic iron	40·89 ,,
Phosphorus	Traces.
Sulphur	Traces.

"Both the phosphorus and the sulphur are present in such minute quantities that the ore may be regarded as virtually free from them; and these are the only really deleterious substances present, for although there is too large a quantity of silica and gangue present in this superficial portion of the vein to permit of malleable iron being made from it by a direct process, it is extremely well adapted for reduction in the blast furnace.

"*Garnet.*—The garnet occurs both crystallized, in the form of the rhombic dodekahedron, and in the massive state. The crystals are, as is usually the case, very uniform in size; they are nearly all of them either about $\frac{1}{8}$ or $\frac{1}{4}$ of an inch in diameter.

"The faces of the crystals are smooth, free from pits and irregularities, and bounded by sharp and well-defined edges. The colour is brown without any red shade.

"Portions of the massive garnet and aggregations of crystals are hard and compact, whilst in other parts they are more or less disintegrated and friable.

"The average percentage of metallic iron is 21·05—an amount not much less than that contained by many commonly smelted ores." *

The following analyses were made upon an intimate mixture of the two minerals as they occur in specimens collected by myself in 1874. †

Analysis.

Water lost at 100° C.	·30	
,, combined	1·63	
Silica	16·28	
,, soluble	2·51	
Alumina	1·35	
Iron protoxide	3·67	= 41·87% metallic iron
,, sesquioxide	55·74	
Manganese protoxide	2·99	
Lime	14·28	
Magnesia	·62	
Sulphur	traces	
Phosphoric acid	traces	
Carbonic acid	·54	
Loss	·09	
	100·00	

The finely divided ore was then separated by means of a magnet, the magnetic and non-magnetic parts being examined separately.

The portion removed by the magnet amounted to 56 per cent., but as will be seen by the following analyses it was found impossible by this means to obtain the magnetite quite free from the vein stuff.

Analysis.

	Magnetic.	Non-magnetic.
Water lost at 100° C	·26	·21
,, combined	1·69	1·14
Silica	8·61	28·66
,, soluble	·65	3·88
Alumina	1·97	1·13
Iron protoxide	6·91	·56
,, sesquioxide	70·47	35·91
Manganese protoxide	2·39	1·62
Zinc-nickel, traces of	·13	....
Lime	6·96	24·44
Magnesia	·20	1·00
Phosphoric acid	traces	....
Sulphur	traces	....
Carbonic acid	absent	1.66
	100·24	100·21

The non-magnetic part thus answers to the general formula for the iron-lime-garnet, $3\ CaO,2\ SiO_2 + Fe_2O_3, SiO_2$.

* See also "Iron and Coal Deposits, Wallerawang." A. Liversidge, *Jour. Roy. Soc., N.S.W.*, *1874.*
† New South Wales Minerals. A. Liversidge, *Jour. Roy. Soc. of N.S.W.*, *1880.*

Mr. Dixon has also made an examination of later specimens of the magnetic ore, with the following results *(Annual Report of the Department of Mines, Sydney, 1880)*:—

Analysis.

Water	2·16	
Ferric oxide	64·01	metallic iron, 51·73.
Ferrous oxide	8·99	
Manganese	traces	
Alumina	2·75	
Lime	3·75	total lime, 11·28.
Fluoride of calcium	10·68	
Magnesia	·41	
Phosphoric oxide	trace	
Sulphur	none	
Silica	6·70	
	99·45	

He found the composition of the garnet rock or vein stuff associated with the magnetite to be as follows:—

Analysis.

Water	4·55	soluble in acid, 31·70.
Ferric oxide	23·14	
Alumina	4·31	
Lime	4·25	
Magnesia	traces	
Phosphoric oxide	none	
Sulphur	none	
Ferric oxide	20·77	insoluble in acid, 65·59.
Alumina	·85	
Lime	7·75	
Silica	34·22	
	99·84	
Metallic iron	30·73	

A lamellar magnetite of good quality occurs in quartz at Carcoar associated with iridescent botryoidal brown hæmatite, and at Combullanarang with copper ores.

It is also found at Inverary Quarry, county Argyle, where Stutchbury mentions that it occurs in the pisolitic form, associated with a black non-magnetic ore in rounded particles the size of peas, and cemented together by a variety of crystallized minerals. Crystallized and compact magnetite occurs near the limestone quarries on Belubula Creek, county Bathurst. Rounded and polished nodules of magnetic iron ore occur in the Lachlan River with ilmenite; it is also found in nearly all the gold and gem bearing drifts and deposits.

Deposits of magnetite are said to exist between the Bogan and Lachlan Rivers, about 100 miles N.W. of Forbes; on Jugiong Creek, near Wellington and Binalong, county Harden, associated with malachite; between Cooyal and Warrabil Springs, county Phillip, associated with brown hæmatite; Rocky River; Barraba, county Darling, with chrome iron; massive magnetite with a granular structure at Bogolong; on Clear Creek, Peel River, county Parry, containing both gold and silver,—one sample yielded 2 dwts. 5 grains per ton of the two metals. (*Annual Report of the Mining Department*, Sydney, 1878, p. 11.) Also found 10 miles from Cowra, on the Grenfell Road, county Forbes; at Burra Burra, Parkes District, county Ashburnham; Mitchell's Creek, county Roxburgh; and at Brown's Creek, near Carcoar, county Bathurst; with zircons at Talbragar, county Bligh. Magnetite in the form of small grains and crystals is common in the creeks in basaltic districts.

HÆMATITE.—Red Hæmatite, Specular Iron.

Chem. comp. : Iron oxide $Fe_2 O_3$. Iron, 70 ; oxygen, 30 = 100.

Hexagonal system, in rhombohedral forms. Usually massive, platy, or micaceous. Well-formed crystals are at present almost unknown here. Specular iron ore occurs in a coarse-grained granite at Summer's Hill, near Bathurst, and at Mount Lambie; also at Bookham, county Harden, and Yass, county King, with micaceous and massive red hæmatite; micaceous hæmatite also occurs at Pine Bone Creek, with titaniferous iron.

"*Specular Hæmatite* was found at Carwary in the Shoalhaven District in abundance; near the spot was a vein of ironstone of a fused appearance; a quartzose ferruginous conglomerate, and a calcareous tuff containing fragments of these rocks."—*Mitchell's Eastern Australia, Vol. II., p. 321.* Also found at Carwell; micaceous hæmatite at Boro, in the county of Murray; parish of Ponsonby, near Bathurst; between Mylora and Bookham, in the Yass District; O'Connell Plains, in the county of Westmoreland, and in the New England District. Specular iron also occurs at Tumut, county Buccleugh.

Of the hæmatite near Carcoar, the late Mr. Stutchbury speaks as follows:—"In a gully or creek called the Waterfall Creek, running into the Cardiangullong Creek, and at the extremity of a mountain spur known as the Rocky Ridge, there is an immense mass of oxydulous iron (hæmatite) forming in one solid mass a precipitous waterfall of about 60 feet in height; in this mass of iron, especially in the joints, there are brilliant crystals of iron pyrites, with a small quantity of yellow copper ore and traces of blue and green carbonate of copper. Here also is found iron sulphate, from the decomposition of the pyrites.

In the cliffs at Shepherd's Hill, Newcastle, there are trunks of trees converted into red hæmatite.

Large deposits of massive and somewhat ochry red hæmatite occur at Brisbane Water, also over large areas in the county of Argyle. This same mineral enters largely also into the composition of the so-called "red hills" occurring in the New England Tin Districts and other parts. A silicious red hæmatite is also common in the Hawkesbury sandstone, about Sydney, and elsewhere, in irregular deposits, filling veins, crevices, and joints, also as concretionary masses and nodules. Is often more or less mixed with sand and other impurities.

The following analysis was made upon a specimen collected in the neighbourhood of Sydney:—

Specific gravity, 4·49.

Analysis.

Water lost at 104° C.	·646
Silica	4·210
Alumina	·713
Iron sesquioxide	90·555
,, protoxide	3·632
Manganese	trace
Lime	—
Magnesia	—
Sulphur	—
Phosphoric acid	absent
Loss	·244
	100·000

The above results show the specimen to be an extremely good iron ore.

One of the nodules used for gravelling garden walks about Sydney contained 28·0 per cent. of metallic iron, and one of the compact red hæmatite from Nattai gave 45 per cent.

GOETHITE.—Brown Hæmatite.

Chem. comp.: Hydrated sesquioxide of Iron $= Fe_2O_3,3H_2O$. Iron sesquioxide, 89·9; water, $10·1 = 100$. Crystallizes in the rhombic system.

Generally massive, or with fibrous radiate structure, minute velvety crystals are sometimes met with; also scaly, mammillated, pisolitic, reniform, and stalactitic.

Externally the colour is often jet-black with high lustre; within yellow, yellowish-brown, and full-brown. Streak, brown.

Many of the nodules of brown hæmatite contain cavities and hollows holding a soft black substance like manganese dioxide, which hardens on exposure.

Very large and extensive irregular deposits and pockets of brown hæmatite occur at Wallerawang, Blackheath, Newbridge, and Lithgow Valley in the county of Cook; Jamberoo, Nattai, Berrima, Mount Keira, Mittagong, and Broughton Vale in the county of Camden; Port Hacking, county of Cumberland; near Gundagai; Mount Tellulla; Newbridge or Back Creek near Blayney, county of Bathurst; deposits of this ore are being worked and smelted at Lithgow; near Cooyal, county of Phillip; 8 miles from Jervis Bay, county of St.

Vincent; Burra Burra, county of Ashburnham; Narrandera, county of Cooper; 50 miles west of Forbes, Lachlan River; Narellan Creek, county of Monteagle; Scone, county of Brisbane; near West Maitland; in the Coal Ranges, Clarence River; at Tamworth, county of Inglis; between the Lachlan and Bogan Rivers; and in many other places such as between Mount Tomah and Mount King George. In fact this mineral is one of the most widely diffused. Between Cooyal and Warrigal Springs, a wide vein of brown hæmatite is reported with magnetite. Pseudomorphous crystals of iron pyrites changed into brown hæmatite occur at Carwell.

A specimen of brown hæmatite from Manly Beach, near Sydney, possessed a somewhat laminated and concentric structure, with small vesicular cavities, many of which were filled with white and yellow clay-like substances. On partial analysis it gave the following results:—

Water, hygroscopic	1·600
,, combined	13·770
Silica and insoluble matter	12·660
Sesquioxide of iron	60·720
Phosphorus	traces
Sulphur	·075
Undetermined	11·175
	100·000

The 60·720 per cent. of sesquioxide of iron is equal to 42·504 of metallic iron. The undetermined constituents were chiefly alumina, lime, &c. The amounts of sulphur and phosphorus are small, so that the mineral is adapted for use as an ore of iron.

A partial analysis of a nodular specimen of brown hæmatite, from Wallerawang, yielded the following results:—

Water, hygroscopic	1·28	
,, combined	12·04	
Silicia and insoluble matter	12·19	
Sesquioxide of iron	73·60	= 51·2 per cent. metallic iron.
Phosphorus	·12	
Sulphur	·06	
Undetermined	·71	
	100·00	

A massive specimen, but somewhat vesicular in places, from the neighbourhood of Jamberoo, dark brown to pitchy black colour, brown streak, was found to have the following composition:—

Specific gravity, 3·52.

Analysis.

Water lost at 105° C.	1·335
,, combined	11·872
Iron sesquioxide	77·155
Alumina	1·232
Manganese	·428
Lime	·257
Magnesia	trace
Silica	8·507
	100·786

Massive brown hæmatite from Uralla found with the titaniferous iron ore.

Specific gravity, 3·611.

Analysis.

Water lost at 100° C.	1·787
,, combined, by difference	10·652
Silica	3·782
Alumina	·159
Iron protoxide	3·526
,, sesquioxide	77·132
Manganese protoxide	·940
Lime	2·022
Magnesia	traces
	100·000

The next three analyses are by Mr. W. A. Dixon *(Annual Report of the Mining Department, Sydney,* 1880) :—

Brown Hæmatite from Gosford, Brisbane Water :—

Analysis.

	No. 1	No. 2
Water	10·73	7·39
Ferric oxide	60·99	41·24
Alumina	·82	1·71
Lime	traces	traces
Magnesia	·41	......
Phosphoric oxide	·03	·02
Sulphur	traces	traces
Alumina	1·84	3·65
Silica	25·10	46·44
	99·92	100·45

Brown Hæmatite from Wallerawang. Specific gravity, 3·572.

Analysis.

Water	15·25	Soluble in acid, 93·56
Carbonic acid	traces	
Ferric oxide	75·52	
Ferrous oxide	1·01	
Manganese oxide	traces	
Alumina	·97	
Lime	·19	
Magnesia	·21	
Phosphoric oxide	·38	
Sulphur	·03	
Alumina	2·11	Insoluble in acid, 6·36
Ferrous oxide	traces	
Silica	4·25	
	99·92	
Metallic iron	52·66	

Stalactites of hæmatite are often formed by the ferruginous springs found over the Coal Measures, as at Berrima and Nattai, county Camden, and elsewhere, and the deposits of brown iron from these often contain beautiful impressions of leaves and other objects; also in botryoidal and mammillated forms, with a well-marked concentric structure.

Brown hæmatite is common on the Bingera Diamond-fields in the form of small concretionary nodules, some of which are as spherical as marbles, in other cases they are more or less elongated; or two or three of the globular forms may be joined together. Some possess a curiously wrinkled or corrugated surface, but most are quite smooth but not polished, the material being rather soft. On breaking them open they are seen to have traces of a concentric structure; the outer portions occasionally present indications of a radiate fibrous structure also. The hydrated oxide of iron seems to have been originally diffused through an impure carbonate of lime and magnesia; and afterwards to have segregated together into these concretionary forms; occasionally the nodules are met with enclosed in the matrix of impure magnesite.

Hardness, 3–4; specific gravity, 3·52. The streak or powder is yellow.

Analysis.

Water lost at 105°	3·173
,, combined	7·304
Silica	5·819
Alumina	·634
Iron sesquioxide	81·877
Manganese protxoide	·561
Lime	·503
Magnesia	traces
Loss	·129
	100·000

Similar concretions have been found on the Cudgegong.

Limonite.—A variety of brown hæmatite. Extensive deposits of what are termed *clay band* iron ores occur interbedded with the Coal Measures. These are an earthy variety of brown hæmatite; yet they are often very rich, and as they occur in immense quantities in close association with coal, they form a most valuable source of iron.

The partial analysis of a specimen from Wallerawang* yielded the following results:—

Water, hygroscopic	1·28	
,, combined	3·54	
Silica and insoluble matter	4·60	
Sesquioxide of iron	80·00	= 56 per cent. metallic iron.
Phosphorus	·49	
Sulphur	·11	
Undetermined constituents	9·98	
	100·00	

The following specimen was taken from the outcrop of the uppermost seam at Wallerawang, and had probably been subjected to bush fires, since the proportion of water is far less than is required; and moreover the mineral contains a trace of magnetic iron, and yields a dark chocolate powder instead of the usual yellow-coloured one:—

Analysis.

Water lost at 100°	1·31	
,, combined	4·17	
Insoluble silica	3·63	
Soluble ,,	·51	
Alumina	2·13	
Manganese protoxide	1·60	
Iron ,,	·52	= 60·13% metallic iron.
,, sesquioxide	85·32	
Lime	·35	
Magnesia	·29	
Sulphur	·04	
Phosphoric acid	traces	
	99·87	

Specimens from two other similar deposits, in the same locality, were examined and found to be composed as follows:—

Analysis.

Water lost at 100° C.	1·35	
,, combined	10·29	
Silica	3·66	
,, soluble	·07	
Alumina	1·38	
Iron protoxide	·67	= 55·80% metallic iron.
,, sesquioxide	78·96	
Manganese protoxide	2·43	
Lime	·65	
Magnesia	·14	
Phosphoric acid	traces	
Sulphur	traces	
	99·60	

* See also "Iron and Coal Deposits at Wallerawang," by A. Liversidge, *Jour. Roy. Soc. N.S.W.*, 1874.

Analysis.

Water lost at 100° C.	·97	
,, combined	10·07	
Silica	8·34	
,, soluble	·27	
Alumina	1·20	
Iron protoxide	·46	= 54·46% metallic iron.
,, sesquioxide	77·29	
Manganese protoxide	·76	
Lime	·19	
Magnesia	·28	
Phosphorus	traces	
Sulphur	traces	
	99·83	

Other specimens from these seams in the same locality yielded 49·28 and 53·31 per cent. of metallic iron respectively.

Limonite, or "clay band ore," occurs at Eskbank, interbedded with the coal measures; in masses of an irregular cuboidal form, containing cavities, closely answering in shape to the external form; in some instances these cavities are more or less completely filled with yellow ochre. A partial analysis of such a specimen yielded the following results:—

Water, hygroscopic	1·730
,, combined	13·560
Silica and insoluble matter	13·520
Sesquioxide of iron	66·320
Phosphorus	traces
Sulphur	·192
Undetermined	4·678
	100·000

The 66·320 per cent. of sesquioxide of iron is equal to 46·424 per cent. of metallic iron.

The following clay band iron ore from Jamberoo; of a dark reddish brown colour; shows how very much some of these "clay band" ores vary. Has a somewhat laminated structure; breaks with a flat conchoidal fracture, with dull earthy surfaces.

Specific gravity, 2·73.

Analysis.

Water lost at 105° C.	1·452
,, combined	11·000
Silica and insoluble matter	57·258
Alumina	15·070
Iron sesquioxide	13·019
,, protoxide	1·255
Manganese	·257
Lime	·158
Magnesia	traces
Phosphoric acid	traces
Sulphur	absent
Loss	·531
	100·000

The following analysis of "clay band," from Wallerawang, is by Mr. Dixon. It had a curious concretionary structure, containing numerous cavities filled with yellow ochre in some cases; in others with a dark grey matter scarcely soluble in acid.

Specific gravity, 3·255.

Analysis.

Water, with traces of organic matter	12·00	Soluble in acid, 75·45.
Ferric oxide	59·87	
Ferrous oxide	2·26	
Manganese oxide	traces	
Alumina	·51	
Lime	·16	
Magnesia	·17	
Phosphoric acid	·44	
Sulphur	·04	
Alumina	7·45	Insoluble in acid, 24·36.
Ferrous oxide	traces	
Silica	17·21	
	100·11	
Metallic iron	43.5	

Similar clay bands exist in the Buttar Ranges, near to East Maitland; at Mount Wingen, county Brisbane; at Mount Lambie in the Coal Measures, where both magnetite and micaceous hæmatite also occur; and elsewhere.

Large outcrops of limonite occur at Lithgow and Bowenfels; also in the Illawarra District at Bulli, where it is said to have a thickness of 20 feet. Assays of this, made at the Royal Mint, Sydney Branch, yielded 32·9, 38·9, 44·3, and 55·7 per cent. metallic iron.

Pisolitic Iron Ore.—Is another of the less pure forms of hæmatite.

Large superficial deposits of pisolitic and brecciated iron ore, red and brown, occur near Bungonia and Windellama Creek, county Argyle, and overlie the slate more or less continuously between Bungonia, Jacqua Creek (with limestone), Dog Trap, and Spring Creeks, forming what are known as the "Made Hills"; also at Windsor. Concretions of ironstone more or less diffused throughout the shales of Cumberland. A pea-iron ore occurs in the coal at Nattai, county Camden, and near Bungonia there is an auriferous argillaceous iron ore. At the Boro Creek, county of Argyle, there is a botryoidal pisolitic ore.

The same variety occurs at Brisbane Water, county Cumberland.

The "Made Hills" which lie between the Macintyre River and Cope's Creek are composed of the same material.

Red and Yellow Ochres.—Are closely allied to the above hæmatite iron ores, and are usually found associated with them, but they generally contain more earthy matter.

Spathic Iron Ore.—Chalybite.

Siderite, Sphærosiderite.

Chem. comp.: Iron carbonate = $FeCO_3$. Iron oxide, 62·1; carbonic acid, 37·9; = 100.

Crystallizes in the hexagonal system in rhombohedral forms.

Occurs in minute crystals at Gulgong, county Phillip. It is also found at Newstead Mine, New England, with arragonite; and in amygdaloidal cavities in basalt at Inverell; in basalt and conglomerate at Rocky Ridge; at Jordan's Hill, Cudgegong River, county Wellington; also in the Hawkesbury sandstone.

Thick bands of grey-coloured impure carbonate of iron, some of which contain about 10 per cent. of metallic iron, occur in the Coal Measures at Jamberoo, county Camden; the siderite is in the form of small particles diffused through a compact grey-coloured argillaceous limestone.

The following analysis was made of the whole to ascertain its value as an ore of iron, as it was found impossible to separate the particles of siderite.

Specific gravity, 2·79.

Analysis.

Water lost at 105°C.	·932
„ combined	11·922
Silica and insoluble matter	42·292
Alumina	22·837
Iron protoxide	12·870
Manganese protoxide	1·048
Magnesia	traces
Potash soda	traces
Phosphoric acid	traces
Carbonic „	7·816
Titanic „	·716
	100·433

Siderite is also said to occur in the neighbourhood of Wentworth.

Chrome Iron.—Chromite.

Chem. comp. : Iron chromate = $FeCrO_4$. Iron oxide, 32·0 ; chromic acid, 68·0 = 100.

Cubical system.—Usually occurs massive, with a granular or lammellar structure, and as small crystals and water-worn grains in gold and gem bearing sands. Black in colour.

A specimen of the massive variety of chromate of iron from Woolomi, Tamworth, had a black colour, and sub-metallic lustre. On certain portions the specimen exhibits curved, somewhat fluted, polished surfaces, closely resembling the smooth and lustrous surface of a slickenside.* It may not be out of place to mention that this resemblance to a slickenside is not at all uncommon in many compact clay deposits, in steatite, serpentine, and other rocks ; it is also often well shown in many specimens of the mineral noumeaite.

To distinguish this structure from the true slickenside I have proposed the term *petaloidal*, from the resemblance which the typical examples of such surfaces often roughly bear to the curved and fluted petals of an unopened flower bud

This specimen contained 64·72 per cent. of chromium sesquioxide, and 21·11 per cent. of iron protoxide.

Chrome iron is found in the Gwydir River and many of its tributaries ; in Nundle Creek and Hanging Rock, county of Parry ; the Horton River ; Two-mile Creek, county Roxburgh ; Stony Batta, in the county of Hardinge, with serpentine ; in the Bingera, Reedy, Gundamulda, Kennedy, and Angular Creeks, county of Murchison ; at Gulgong and Mudgee, county Phillip ; Ironbarks, county Wellington ; on the Murrumbidgee River ; near Yass ; Barraba, county Darling ; near Grafton and Gordon Brook, Clarence River ; with chrome ochre at Uralla, county Sandon. At Woolomi, 16 miles north of Hanging Rock, on the Peel River, is a large deposit of chrome iron in serpentine. Chrome iron is usually to be expected where serpentine exists.

Scorodite.

Chem. comp. : An arseniate of iron, $Fe_2As_2O_8$, $4H_2O$. Arsenic acid, 49·8 ; sesquioxide of iron, 34·7 ; water, 15·5 = 100.

Rhombic system.—With iron pyrites, Cadell's Reef, Mudgee Road, 9 miles south-east of Mudgee ; also at Louisa Creek, county Wellington.

Pharmacosiderite.

Chem. comp. : An arseniate of iron. Arsenic acid, 43·13 ; sesquioxide of iron, 40·0 ; water, 16·87 = 100.

Cubical system.—Found crystallized in small olive-green cubes. Subtranslucent.

Locality.—To the east of Bungonia, county Argyle.

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* A slickenside is the smooth polished and striated surface occasionally exhibited by the walls of faults and slides ; in such cases, however, the peculiar structure has doubtless been induced by friction accompanied by intense pressure.

Vivianite.

A hydrated phosphate of iron. $Fe_3P_2O_8,8H_2O$. Phosphoric oxide, 28·3; iron protoxide, 43·0; water, 28·7 = 100.

Dr. Leibius, of the Royal Mint, Sydney Branch, forwarded for identification a specimen of this mineral to me in March, 1882, which I believe is the first found in the Colony.

The specimen came from the Nymagee Copper-mine, where it was found associated with copper pyrites. Externally the fragment is partially surrounded by layers of carbonate of iron and iron pyrites; it looks as if the vivianite had crystallized within a kind of geode; the mineral is translucent and shows the usual changing green and deep blue tints when viewed from different positions. No complete crystals were present.

Titaniferous Iron.

Chem. comp.: Iron and titanic acid.

There are several different kinds of titaniferous iron, distinguished by their physical properties and by the amounts of titanic acid which they contain—such as ilmenite, iserine, menaccanite, &c. Until those found in New South Wales have been examined, it will be as well, perhaps, to class them all under the general head of titaniferous iron.

Occurs in a quartz vein near Wellington.

Found usually with alluvial gold; as at Ophir, Mudgee, and Wellington, in the county of Wellington; Bathurst; Bingera, county of Murchison; and Uralla, county of Sandon, in the diamond drift. Large rolled masses occur at Uralla. Ilmenite, menaccanite, nigrine, and iserine are said to occur with gold, garnets, and chrysolites in the Five-mile Flat Creek, Cudgegong River, in the Lachlan and at Talbragar, with magnetite; also near Wagga Wagga, county of Wynyard, and the Rocky River, county of Hardinge.

Nigrine.—Burrandong, county of Wellington. In small grains, for the most part rounded, but with traces of crystal faces on some of the fragments.

A variety of titaniferous iron ore found in the river deposits, near Uralla, by miners working for gold; in the form of black pebbles, with a sub-metallic lustre, was composed as follows:—

Specific gravity, 4·44.

Analysis.

Silica	9·491
Alumina	14·799
Titanic acid	44·506
Metallic iron	23·019
Oxygen	8·185
Lime	traces
Magnesia	traces
	100·000

The iron exists in the form of both protoxide and sesquioxide, the former being present in the larger quantity. As it is difficult to determine accurately the amount of protoxide in a difficultly soluble mineral such as this, the total iron has been stated as metallic iron, and the oxygen estimated by difference. The alumina and silica doubtless exist in combination as silicate.

Chloropal.

Found in veins in the basalt at Two-mile Flat, near Mudgee. Of a pistachio-green colour—earthy, somewhat fibrous in parts, looks like a decomposition product. Friable; the fracture is splintery to earthy. H. 2–3.

Specific gravity, 1·94. Yields a green powder. Emits an argillaceous odour when breathed upon. Before the blowpipe blackens, does not fuse, becomes magnetic. With hydrochloric acid is decomposed, silica being left. Does not gelatinize.

Analysis.

Water lost at 105° C.	12·313
„ combined	5·224
Silica	49·657
Iron sesquioxide	29·108
Manganese	traces
Lime	2·606
Magnesia	·508
Soda	·599
Potash	·170
	100·185

Iron Pyrites.

Chem. comp. : FeS_2. Sulphur, 53·3 ; iron, 46·7 = 100. Crystallizes in the cubical system. Occurs massive and crystallized, the most common forms being the cube and the pentagonal dodekahedron. Well-formed cubes, partially decomposed into brown hæmatite, are common in many deposits with gold, and are known to the miners by the name of "devil's dice," especially in the gem sand at Walker's Crossing, on the Cox River, about 1½ miles below Wallerawang. All specimens of pyrites which I have examined have without exception contained traces of gold, and in some cases large amounts.

As is found to be the case in other parts of the world, this mineral is almost universally diffused throughout the metalliferous districts of the Colony, and is found in rocks of all ages.

Well-formed crystals are found in the Manilla and Namoi Rivers, county Darling. In the tin district of New England it is very common, also in the Bathurst District; at Gulgong, well-formed pentagonal dodecahedra are common in the auriferous quartz veins. Very abundant in the Adelong reefs, county Wynyard; the Carcoar District; at Kiandra, county Wallace, crystallized in cubes with molybdenite. Well crystallized specimens are said to occur in a chlorite schist near Grenfell. Masses of iron pyrites, or even large crystals, which are superficially changed into brown hæmatite break with deep conchoidal fractures; and these fresh surfaces possess a very remarkable lustre; two such specimens had a specific gravity of 4·975 and 4·990.

Marcasite.—Rhombic pyrites. Chem. comp. : Iron sulphide = FeS_2. The same as the former, of which it is an allotropic form.

Fluted rhombic crystals occur with arsenical and common pyrites (auriferous) to the south of Reedy Creek, Shoalhaven River; also at Carcoar, county Bathurst, with galena and other minerals.

Pyrrhotine.—Magnetic pyrites.

Chem. comp. : Fe_7S_8. Sulphur, 39·5 ; iron, 60·5 = 100.

Hexagonal system.

More of a copper-colour than the other pyrites, slightly magnetic, and crystallizes in six-sided forms.

It occurs with gold and calcite at Hawkins' Hill, county Wellington.

Yenite.—Ilvaite.

Chem. comp. : Double silicate of iron and calcium. Crystallizes in the form of rhombic prisms.

The late Rev. W. B. Clarke reported that he had found drifted pieces on the Tuggerah Lake beach. As it appeared to be a new variety, he named it, provisionally, Baddeleyite, after the finder.

Return showing the quantity and value of iron produced in the Colony of New South Wales *(Annual Report of the Department of Mines, Sydney)* :—

Year.	Quantity. Tons.	Value. £
1874	....	15,434 *
1875	40	502
1876	2,680	13,399
1877	2,600	7,600
1878	900	6,666
1879	1,118	10,550
1880	2,322	15,335
1881	6,560	47,891
Total	16,220	117,357

Manganese.

The ores of manganese do not appear to have been discovered in any great abundance in New South Wales.

Pyrolusite.—Black Oxide of Manganese.

Chem. comp. : MnO_2. Crystallizes in the rhombic system, but more usually found massive. Louisa Creek, county of Wellington; said to occur in large quantities near Caloola, county of Bathurst.

Wad.—Asbolite.

An impure oxide of manganese.

At Long Gully, near Bungonia, county Argyle, it is met with having a more or less botryoidal form and platy structure; of a black colour; soft with a black shining streak; in association with quartz, both as small veins running through the quartz and as an external coating or incrustation. A specimen from this locality was found by Dr. A. M. Thomson to contain 1·57 per cent. of cobalt, and 0·36 per cent. of nickel.

The following were examined by Mr. W. A. Dixon, F.I.C. (*Annual Report of the Department of Mines*, Sydney, 1879) :—

Wad from Trunkey gave on analysis :—

Silica	25·84
Oxide of iron and traces of alumina	24·72
Oxide of manganese	34·93
Oxide of cobalt and traces nickel	2·11
Magnesia	1·00
Water	11·15
Alkalies and loss	·25
	100·00

Samples from Boro, Goulburn District, consisting of oxide of manganese mixed with quartz, contained :—

Available oxide of manganese (MnO_2)	23·27	37·84
Other substances soluble in acid, chiefly oxide of iron	29·33	22·76
Quartz	47·40	39·40
	100·00	100·00

Another specimen yielded 77·2% of available dioxide and traces of cobalt.

* These figures represent the value of iron raised prior to the year 1875; quantity not known.

Mr. M. Pattison Muir, F.R.S.E., gives the following account of a Manganese ore from near Bathurst (*Chemical News, 1877*, p. 6) :—"The sample was greyish black in colour ; when broken it exhibited an ill-defined crystalline structure, and showed patches of dark brown or black, intermingled with others of dark steel grey colour.

"When heated in a small glass tube a considerable quantity of water was evolved.

"The amount of manganese dioxide was determined by the oxalic acid method of Fresenius and Will ; the total quantity of manganese was also determined by precipitation with bromine water, after removal of ferric and aluminic oxides ; the excess of manganese above that required for the formation of the amount of dioxide found to be present, was calculated to protoxide.

"The following are the results of the analysis :—

Manganese dioxide	78·72	per cent.
,, protoxide	3·66	,,
Ferric and aluminic oxides	6·50	,,
Silica	5·80	,,
Moisture	4·75	,,
	99·43	

"If the percentage amount of manganese dioxide be calculated on the dried specimen it is found to amount to 82·21."

It is abundant in the diamond drift near Mudgee, both as a cement and incrustation ; often dendritic in outline. The incrustation on many of the pebbles is evidently quite recent.

It is very common as dendritic markings on rocks in many parts of the Colony.

It is found to the north of Katoomba, Govett's Leap, and other places on the Blue Mountains ; in fact, it occurs in the Hawkesbury sandstone under similar conditions to the hæmatite, as embedded nodules and loose on the ground ; also at Orange; at Silverdale, Bowning, and Yass, county King; and Mitchell's Creek, county Roxburgh ; in Hall's Creek, Moonbi Range, and at Cootamundra, county of Harden.

A peculiar form of wad is found in cavities in the basalt at Hill End ; this variety is very soft and porous, being composed of minute scales arranged loosely together in a concentric manner—in fact, having a structure similar to that of wood ; externally it has somewhat a frothy appearance, with a metallic lustre, so soft that it blackens the fingers and will hardly bear handling without crushing.

A massive variety of wad has been sent down in large blocks from the Wellington District from time to time ; it occurs at Caloola, and on the Ellenborough River in the Walcha District. A large and well defined lode is said to exist at Fairy Meadows, and samples yielded 70 per cent. of available dioxide of manganese.

Psilomelane occurs in the drift, Three-mile Diggings, Kiandra.

Kupfermanganerz.—Cuprous manganese.

Chem. comp. : An impure oxide of manganese, containing a small percentage of black oxide of copper and oxide of cobalt.

Found in the Coombing Copper-mine, with native copper, cuprite, copper carbonates, and sulphides.

Braunite.

Chem. comp. : Manganese oxides, and manganese silicate. Crystallizes in the pyramidal system, also massive. At Rylstone, Port Macquarie and Bungendore, county of Murray ; at Caloola, near Gundagai, and in the Wellington district.

A hard compact specimen, with a very minute crystalline structure; strikes fire with steel; fracture conchoidal; of a dark iron-grey colour. From near Wellington.

Specific gravity, 6·465; hardness, 6·5.

Soluble in hot strong hydrochloric acid, with evolution of chlorine, a residue of white silica being left.

Analysis.

Silica	11·778
Alumina	4·061
Iron sesquioxide	3·153
Manganese protoxide	31·516
,, dioxide	50·125
Lime	traces
Magnesia	traces
	100·633

This mineral is one of unusual hardness and specific gravity for one consisting essentially of the oxides of manganese. The silica is probably present merely as an impurity in combination with the iron and alumina.

Manganblende.—Alabandite.

Manganese sulphide.—MnS. It is said to have been found at Rylstone.

Iron black in colour, with brown tarnish; green streak.

Cobalt.

Minerals containing cobalt, except wad and pyrites, do not yet appear to have been found in New South Wales.

Nickel.

Kupfernickel.—Copper-nickel.

Chem. comp.: Nickel arsenide = NiAs., Ni = 44·1 : As = 55·9 = 100.

Hexagonal system.—A massive variety, of a copper-red colour, in parts incrusted with pale green nickel hydrate, is reported from near Bathurst.

Found by the Rev. W. B. Clarke, on the Peel River, and to the south-west of Weare's Creek. Yellowish white in colour, highly magnetic. Sp. gr. = 8; H. = 5·5; and dissolving readily in nitric acid.

Zinc.

Zinc Blende.

Chem. comp.: Zinc sulphide = ZnS. Zinc 67·0, sulphur 33·0 = 100. Found massive, and crystallised in small hemihedral forms belonging to the cubical system. Many of the crystals have beautiful bronze and purple metallic tints.

With tin, gold, manganese, copper pyrites, galena, and other minerals, on Major's Creek, near Bungonia, county Argyle. A specimen from the Braidwood District was found to contain 15 dwts. 16 grs. of gold and 11 ozs. 15 dwts. 4 grs. of silver per ton.

With gold, iron, copper pyrites, black oxide of copper, galena, and asbestos, in a quartz vein, Wiseman's Creek, near Bathurst. Orange, Louisa Creek. And with copper ores at Cow Flat, county Bathurst; with argentiferous galena and copper pyrites, Sunny Corner, Mitchell's Creek; at Winterton with barytes, &c.; Adelong, with pyrites; at Silverdale, near Bowning.

Cerium, Lanthanum, and Didymium.

Monazite.

The following description and analysis of a specimen of Monazite from Vegetable Creek, county Gough, is by Mr. W. A. Dixon, F.I.C., of the School of Arts, Sydney :—

Analyses.

		Duplicate.
Phosphoric acid	25·09	24·61
Oxide of Cerium	36·64	68.08
,, Lanthanum, ,, Didymium	30·21	
,, Thorinum	1·23	
,, Manganese	traces	
,, Magnesium	traces	
,, Aluminium	3·11	
Silica	3·21	
	99·49	

Specific gravity, 5·001.

"The mineral was crystalline, but the crystals were broken and ill-defined, one piece, however, appeared to be a monoclinic prism. Colour, yellowish red, in thin pieces semi-transparent; it gave a white streak, showing a hardness about 5· ; it was rather brittle, and gave a yellowish powder infusible before the blowpipe.

"The raw mineral was found to be scarcely acted upon by concentrated hydrochloric acid even when reduced to an impalpable powder and the action continued for twenty-four hours, and even after fusion with alkaline carbonates it was only partly soluble. The method adopted was to fuse it with three times its weight of carbonate of potassium and sodium, with the addition of a little nitrate of potassium. The fused mass treated with water gave a solution, in which silica, alumina, and phosphoric acid were determined, and a voluminous residue. The residue was heated with concentrated sulphuric acid for some hours, the temperature being raised at last sufficiently to drive off most of the free acid, and then treated with concentrated hydrochloric acid, which gave a yellow or orange solution, which colour disappeared on dilution. The cerium metals were precipitated from the solution, which was first nearly neutralized by ammonia, by oxalate of ammonium; the oxalates were ignited and weighed, dissolved in hydrochloric acid reprecipitated by potash free from sulphate, and chlorine passed into the liquid until it was fully saturated; allowed to stand overnight, when the undissolved cerium oxide was filtered off, redissolved in acid, precipitated as oxalate, ignited and weighed. The solution containing Lanthanum, Didymium, and Thorinum was boiled to expel the excess of chlorine, and the last precipitated by sodium thio-sulphate, sulphuric acid being first tested for in both solution and reagent and found to be absent; the precipitate was converted into oxalate and ignited to oxide which was weighed. The percentage of oxide of lanthanum and didymium was taken as the difference between the weights of the first precipitation and the last two together, and as there is no satisfactory process for quantitatively separating them it was not attempted, but it was easily seen that didymium was present in comparatively small quantity.

"I have entered thus closely into the process employed as the mineral appears to be "Monazite," in which the presence of thorinum has been denied by some who assert that a sulphate of one of the other metals was mistaken for it. For the formula usually given for Monazite $(Ce^{\cdot}\ La^{\cdot}\ Te^{\cdot})_3\ P$ the quantities of the oxide found would require 29 per cent. of phosphoric oxide, but the close agreement in the two determinations made, both of the acid and oxides, show that the former is deficient. From the second determination of oxide the amount of oxygen corresponding to the difference between the ceroso-ceric oxide as weighed, and cerous oxide has been deducted on the assumption that the precipitate contained the same quantity of cerium as was found in the first instance.

"As the formula of Monazite is somewhat uncertain, and as such minerals have of late yielded new metals in minute quantities, I regret that the quantity at my disposal has prevented me making a more searching investigation of it."—*Annual Report of the Department of Mines*, Sydney, 1881.

PART II.

NON-METALLIC MINERALS.

Class I.

Carbon and Carbonaceous Minerals.

Diamond.

Chem. comp. : Carbon, usually accompanied by a small percentage of ash or mineral matter. Cubical system. The first mention made of the existence of the diamond in New South Wales, which I have been able to find, is one by Mr. E. H. Hargraves, who, in his report dated from the "Wellington Inn," Guyong, on the 2nd July, 1851, refers to some enclosed specimens of gold, gems, and "a small one of the diamond kind," from Reedy Creek, 16 miles from Bathurst. The next record of the occurrence of the diamond in New South Wales appears to have been made by the Rev. W. B. Clarke, in an appendix to his "Southern Gold-fields," published in 1860; he records that four were brought to him on September 21st, 1859, which were obtained from the Macquarie River, near Suttor's Bar; the crystalline form which they exhibited was that of the triakis-octohedron or three-faced octohedron, and one of them had a sp. gr. of 3·40. Another which was received from Burrendong, on December 29th, 1859, had a sp. gr. of 3·50. One from Pyramul Creek, crystallized in the hexakis or six-faced octohedron, weighed 9·44 grains, and had a sp. gr. of 3·49. Another was sent to him in August, 1860, which had been found in the Calabash Creek by a digger as far back as 1852.

Diamonds were found by the gold diggers on the Cudgegong Diamond-diggings, about 19 miles from Mudgee, in 1867, but were not especially worked until 1869.

The diamonds were obtained from outliers of an old river-drift which had in parts been protected from denudation by a capping of hard compact basalt. This drift is made up mostly of boulders and pebbles of quartz, jasper, agate, quartzite, flinty slate, silicified wood, shale, sandstone, and abundance of coarse sand mixed with more or less clay.

Many of the boulders are remarkable for the peculiar brilliant polish which they possess. The principal minerals found with the diamond are gold, garnets, wood-tin, brookite, magnetite, ilmenite, tourmaline, zircon, sapphire, ruby, adamantine spar, barklyite, common corundum and a peculiar lavender-coloured variety; quartz, topaz, magnesite and nodules of limonite which had been set free from an impure magnesite; the chemical composition of similar limonite nodules from Bingera is given on p. 102; black vesicular pleonaste, spinel ruby, and osmo-iridium.

The largest diamond found weighed 16·2 grains, or about $5\frac{5}{8}$ carats.

The average sp. gr. was 3·44, and the average weight of a large number of those obtained was but 0·23 carat. (For further particulars, see paper on the Mudgee Diamond-fields, by Professor Thomson and Mr. Norman Taylor, in the *Transactions of the Royal Society of New South Wales*, 1870, and *Geological Magazine, London*, 1879.) The total number found has been stated roughly at about 6,000; the number also from Bingera must be nearly as many—in all 10,000 at least.

In colour they vary from colourless and transparent to various shades of straw-yellow, brown, light-green, and black. One of a rich dark-green was found in the form of a flattened hemitrope octohedron.

The most common crystalline forms which have been met with are the octohedron, the hemitrope octohedron, the rhombic dodecahedron, the triakis and hexakis octohedron, but they are all usually more or less rounded. The flattened triangular hemitrope crystals are very common; one specimen of the deltoidal dodecahedron was met with.

The lustre is usually brilliant or adamantine, but occasionally they have a dull appearance. This want of lustre is not due to any coating of foreign matter or to the same cause as the dulness of less hard and water-worn crystals, but it is due to the surface being covered with innumerable edges and angles belonging to the structure of the crystal; these reflect the light irregularly at all angles and give the stone its frosted appearance.

The diamonds at Bingera occur under almost exactly the same circumstances as at Mudgee, and with the same minerals, except that I did not come across either the black vesicular pleonaste or barklyite.

From a series of determinations made on nineteen of the Bingera diamonds, I obtained a mean specific gravity of 3·42.*

Some other uncut diamonds from unknown localities, but found in New South Wales, yielded the following specific gravities :—

		Weight.	Specific gravity.	Temperature.
1 diamond, off colour	=	·2920	3·4762	at 20° C.
5 small dark diamonds..................	,,	1·3220	3·5633	,, 18·5 ,,
6 ,, light coloured diamonds......	,,	2·2790	3·5278	,, 18·5 ,,
12 ,, ,, ,, ,, ...	,,	2·7390	3·5233	,, 17·5 ,,
8 ,, dark ,, ,, ...	,,	1·4376	3·5166	,, 17·5 ,,

Diamonds have also been found at Bald Hill, Hill End, with the same gems as at the above-mentioned places ; one octohedral crystal, rather flattened, which I examined, weighed 9·6 troy grains, and had a specific gravity of 3·58.

A specimen of "bort" or black diamond was obtained near Bathurst. It is of about the same size as a large pea, black in colour, with a graphitic or black-lead lustre ; it is very nearly spherical in form, but has a few slight irregular processes, which seem to be due to an attempt to assume the form of the hexakis octohedron.

In weight it is 7·352 troy grains, and at 70° F. the specific gravity is 3·56.

Mr. Wilkinson mentions that from the Bengonover Tin-mine, near the Borah Tin-mine, several diamonds were obtained, the largest being 7·5 grains. From the Borah Tin-mine, situated at the junction of Cope's Creek with the Gwydir, 200 were obtained in a few months ; out of a batch of eighty-six, averaging 1 carat grain each, the largest weighed 5·5 grains. Diamonds have been found on most of the alluvial tin workings at Cope's, Newstead, Vegetable, and Middle Creeks, also in the Stannifer, Ruby, and the Britannia Tin-mines, and elsewhere in the district.

Amongst other places the diamond has been found in the gravels of the Gwydir, Turon, the Abercombie, the Cudgegong, Macquarie, and Shoalhaven Rivers. One was found in August, 1874, in Brook's Creek, Gundaroo, near Goulburn, valued at £3. At Uralla, Oberon, and Trunkey, they are by no means uncommon ; and I have recently obtained a small hemitrope octohedron from the Lachlan River weighing 1·5 grains. They have also been obtained from diggings on the sea-shore near to Ballina.

Diamonds are found in the gravels under the basalt at Monkey Hill and Sally's Flat, county of Wellington, just as is the case on the Cudgegong River and at Bingera.

A drift having almost exactly the same characters as those at Bingera and Mudgee occurs in other districts, as at Wallerawang, and on the Mary River, Queensland—even to the presence of masses of conglomerate of jasper, quartz, and other pebbles agglutinated together by a ferruginous and manganiferous cement. These masses of hard conglomerate are probably derived from the Coal Measures.

GRAPHITE.—Plumbago.

Chem. comp. : Carbon. Hexagonal system. Occurs with quartz, iron pyrites, and pyromorphite at the head of the Abercrombie River ; possesses a curved lamellar structure. Occurs in small radiating masses in the granite at Dundee, in New Valley, and near Tenterfield.

Reported also from Bungonia, but its existence there is doubtful ; also from Pambula, near Eden, in quartz, the Cordeaux River, near Mt. Keira, and Plumbago Creek, near the junction of Timbarra Creek, county of Drake.

Small particles are not uncommon in the Hawkesbury Sandstone about Sydney and other places.

Any black clay or other substance which can be made to leave a mark on paper is brought into Sydney as a sample of a valuable deposit of graphite ; but I have not yet seen, out of many highly extolled specimens, one fit for even the commonest purpose.

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* "Bingera Diamond-fields."—A. Liversidge, *Trans. Royal Soc., N.S.W.*, 1873, and *Journal of the Geological Society of London*, 1873.

The following analysis of a black clay shows the composition of one of these reputed graphites* :—

CARBONACEOUS EARTH.

"A black, earthy, friable material from near Mudgee; soils the fingers readily. In parts it is grey in colour, and here and there an occasional white streak is seen; falls to powder when immersed in water.

"Specific gravity, 2·88.

Analysis.

Hygroscopic moisture	1·60
Combined water (by difference)	13·38
Silica	46·00
Alumina	32·32
Lime	absent
Magnesia	absent
Potash	·17
Soda	·13
Carbon	6·40
	100·00

"The mineral, as shown by the above analysis, is essentially a hydrous silicate of aluminium mixed with a small proportion of carbonaceous matter. The carbonaceous matter is easily burnt off.

"As a fireclay this material would not be of any great value, since it only possesses average refractory qualities. It should be remarked that it is totally distinct from graphite, the mineral for which it is often mistaken by miners."

COAL.

The existence of coal in New South Wales appears to have been discovered in the month of August, 1797. The following reference is made to its occurrence by Collins in his account of the English Colony in New South Wales † :—

"Mr. Clark, the supercargo of ‡the 'Sydney Cove,' having mentioned that, two days before he had been met by the people in the fishing boat, he had fallen in with a great quantity of coal, with which he and his companions had made a large fire and had slept by it during the night, a whaleboat was sent off to the southward, with Mr. Bass, the surgeon of the 'Reliance,' to discover where an article so valuable was to be met with. He proceeded about 7 leagues to the southward of Point Solander, where he found in the face of a steep cliff, washed by the sea, a stratum of coal in breadth about 6 feet, and extending 8 or 9 miles to the southward. Upon the summit of the high land, and lying on the surface, he observed many patches of coal, from some of which it must have been that Mr. Clark was so conveniently supplied with fuel. He also found in the skeletons of the mate and carpenter of the 'Sydney Cove' an unequivocal proof of their having unfortunately perished, as was conjectured.

"By the specimens of the coal which were brought in by Mr. Bass, the quality appeared to be good; but from its almost inaccessible situation, no great advantage could ever be expected from it, and, indeed, were it even less difficult to be procured, unless some small harbour should be near it, it could not be of much utility to the settlement."

During the following month of the same year—*i.e.*, in September, 1797—coal was found to the north of Sydney. On p. 48 Collins states—

"Lieutenant Shortland proceeded with a whaleboat as far as Port Stephens. On his return he entered a river, which he named Hunter River, about 10 leagues to the southward of Port Stephens, into which he carried 3 fathoms water in the shoalest part of its entrance, finding deep water and good anchorage within.

* A. Liversidge.—*Report of the Mining Department*, Sydney, 1876, p. 183. † *An Account of the English Colony in New South Wales*, by David Collins, Esq., late Judge Advocate and Secretary to the Colony, vol. II., p. 45, London, 1798, 1802. ‡ The "Sydney Cove" was wrecked on the coast of Tasmania when on a voyage to Sydney from Bengal.

"The entrance of this river was but narrow, and covered by a high rocky island lying right off it, so as to leave a good passage round the north end of the island between that and the shore. A reef connects the south part of the island with the south of the entrance of the river. In this harbour was found a very considerable quantity of coal of a very good sort, and lying so near the water side as to be conveniently shipped, which gave it in this particular a manifest advantage over that discovered to the southward. Some specimens of this coal were brought up in the boat."

In 1799 it seems to have become customary to send regularly to the Hunter River for supplies of coal, and under the heading of April, 1799, Collins has the following entry in his journal:—

"The discovery of vast strata of coal must be reckoned among the new lights thrown upon the resources of the Colony. The facility that this presents in working the iron ore (some of this iron ore, which has been smelted in England, has been reported to be equal, if not superior, to Swedish iron), with which the settlement abounded, must prove of infinite utility whenever a dockyard shall be established here; and the time may come when the productions of the country may not be confined within its own sphere."

In the early days of the Colony the Hunter was for some time known as the Coal River.

In September, 1800, another entry records the discovery of coal, although in this case the seam appears to have been valueless—

"It having been reported that coal had been found upon the banks of George's River, the Governor visited the place, and on examination found many indications of the existence of coal, that useful fossil, of which, shortly after, a vein was discovered on the west side of Garden Island Cove."

The Australian Agricultural Company, formed in 1826, with a capital of £1,000,000 and a free grant of 1,000,000 acres of land, gave the first impetus to the great coal trade now carried on in the Colony. The Charter possessed by the Company conceded to them the sole right to work the Newcastle coal-beds. This monopoly expired in 1847.

The following account of the coals of New South Wales contains the results of an examination into the chemical composition of certain samples of coal and "kerosene shale"; included with these are one or two carbonaceous minerals which, although they cannot properly be classed with the coals, yet can conveniently be included with them.

I may mention that most of my own analyses were made upon samples of the coals which were collected by the officers of the Mining Department and were reported upon by me to that Department in 1875.* The proportions of moisture, volatile matter, fixed carbon, ash, coke, and sulphur only were then determined, as information upon these points is quite sufficient for all ordinary purposes. Shortly afterwards, as I had the remains of the specimens, I thought it would be desirable to determine the ultimate composition, and to ascertain the chemical composition of the ashes of these coals; the results of these further examinations were published in a paper read before the Royal Society of New South Wales, in Dec., 1880, and published in its Journal for that year. Together with the above are incorporated the analyses made by Mr. W. A. Dixon, F.C.S., published in the *Annual Reports of the Mining Department* for 1878, 1879, and 1880. The samples examined by Mr. Dixon† were collected five or six years after those, from the same mines, analysed by me.

I particularly wished to see how the New South Wales coals compared with those of Europe, and especially with English coals, and to do so, ultimate analyses had to be made, *i.e.*, the amount of carbon, hydrogen, nitrogen, etc., had to be determined; this of course necessitated the expenditure of considerable time and trouble, but it enabled me to ascertain how the calorific intensity of the fuels, calculated from the percentage amounts of carbon and hydrogen, correspond with their evaporative powers as determined experimentally by means of Thompson's calorimeter.

* *Annual Report of the Mining Department, 1875*, p. 127. † *Ibid*, 1880, pp. 22-39.

The ashes were analysed because it was thought that a knowledge of their chemical composition would be of service to the metallurgist as well as of some general scientific interest; it is of course of great importance to the metallurgist to know the composition of the ashes of the coal which he uses, since some of the constituents may have a bad effect upon the products of his furnaces, and in some cases even render the metal useless for certain purposes.

Methods of Analysis.—I may perhaps mention the methods of analysis followed, since it is sometimes of interest to any one going over similar ground to know what processes were employed; and when it is wished to compare results it is often a great advantage to be able to use the same methods. The proximate analyses were made according to the well-known process described in Crooke's "Methods in Chemical Analysis," p. 368; in each case upon about 2 grammes of the freshly powdered coal.

The sulphur was estimated by heating about 2 grammes of the coals with chlorate of potash and strong nitric acid, and then adding strong hydrochloric acid; the solution being largely diluted, filtered, and precipitated in the ordinary way. The reagents were rendered sulphur-free before use.

The specific gravity was determined upon the coal in the form of a coarse powder; the powder was allowed to soak in the specific gravity bottle, and kept in a warm place, until air-bubbles ceased to be evolved; when cold the second weighing was proceeded with.

The carbon and hydrogen were determined by combustion with lead chromate in a current of oxygen; it was found that when cupric oxide and a current of oxygen were employed that the carbon was liable to be understated. The nitrogen was determined in the ordinary way by the soda-lime process.

All the determinations were made in duplicate.

Calculated calorific intensity and evaporative power.—The theoretical evaporative power was determined experimentally by means of Thompson's calorimeter, for a description of which see Dr. Percy's Metallurgy, vol. 1, p. 541. The results given are the means of several experiments. The calorific intensity was calculated according to the formula given by the same author, p. 537.

On examining the two sets of results, *i.e.*, the calculated calorific intensity and the calculated evaporative power as determined by the calorimeter, it will be at once apparent that they do not in all cases place the coals in the same order—there is no doubt that other things besides the absolute quantities of carbon, hydrogen, oxygen, and ash, influence the production of heat and help to determine the value of a coal—we as yet really know very little as to how the combustible elements are combined in coals, or whether there are differences in the mode of such combination in different coals—it is most probable that there are—but we do know that there are considerable variations in the mechanical structure of coals, which must necessarily influence the rate of combustion and the amount of heat generated.

It is a well-known fact that many commanders of steam-vessels belonging to the Royal Navy, the great Mail Companies, and to the Intercolonial lines, prefer southern to northern coal, although the former contains more ash, the disadvantage of the greater proportion of ash is considered to be counterbalanced by the fact that the southern coal burns uniformly and does not form a clinker; but when it is desired to get up steam rapidly, then the rich, so-called bituminous, northern coal is preferred.

In the report* to the Mining Department upon the theoretical evaporative power of certain coals, I pointed out that "these results represent the theoretical calorific or evaporative power of the samples, *i.e.*, the weight of water which would be converted into steam by the complete combustion of one pound of each of the various coals respectively."

"It must, however, be clearly understood that the actual heat-producing or evaporative power of a coal obtained in practice, depends very greatly upon the size, construction, and form of both furnace and boiler, as well as upon the method of firing or burning, and upon many other equally obvious circumstances; it will, therefore, be apparent that the results can only be *rigidly* compared when the conditions under which the fuels are burnt are alike, as was the case in the experimental trials."

**Report of the Mining Department*, Sydney, 1877, p. 207.

Analysis of the Ash.—The ash was prepared for analysis by incinerating the powdered coal in a muffle furnace at a dull red heat; in order to obtain the ash as expeditiously as possible from a fairly large quantity of coal, a tray 10 x 6 x 1 inch deep, made out of stout platinum foil, was used for the incineration.

The ash was rendered soluble by direct fusion with the mixed alkaline carbonates, and proceeded with in the usual manner for silica, alumina, iron, lime, &c.; the alkalies were determined in separate portions by Dr. J. Lawrence Smith's process, *i.e.*, by fusion with calcium carbonate and ammonium chloride.

The phosphoric and sulphuric acids were also determined in separate portions of the ash; as the proportion of phosphoric acid, where present, was shown by the qualitative tests to be small, the molybdic acid process was employed, about 2 grammes weight of ash being taken in duplicate in each case.

The analyses and descriptions of the specimens numbered 4, 5, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18, 19, 22, 23, and 25 are by Mr. Dixon.

NORTHERN DISTRICT.

Anvil Creek.

No. 1. Structure laminated, but compact; not so much mother-of-coal present as in that from the Waratah Mine. Breaks into cuboidal masses. Does not readily soil the fingers. Specific gravity, 1·323.

Proximate Analysis.

Moisture	1·74	
Volatile hydrocarbons	41·10	
Fixed carbon	47·90	Coke, 55·70 per cent.
Ash	7·80	
Sulphur	1·46	
	100·00	

Coke.—Good, firm, bright silvery lustre, not much swollen up.
Ash.—White.
Dried at 100° C.

Ultimate Analysis.

Carbon	77·15
Hydrogen	5·91
Oxygen	6·07
Sulphur	1·48
Nitrogen	1·46
Ash	7·93
	100·00

Calculated calorific intensity, 8,009.

By experiment with the calorimeter 1 lb. of this coal would convert 12·65 lbs. of water into steam.

Analysis of Ash.

	No. 1.	No. 2.
Silica	48·70	50·16
Alumina	38·84	40·50
Iron sesquioxide	2·71	2·00
Maganese	traces	traces
Lime	5·20	4·10
Magnesia	·70	·32
Potash	2·13	2·02
Soda	·43	·12
Phosphoric acid	trace	trace
Sulphuric acid (SO_3)	·85	·56
Loss	·44	·22
	100·00	100·00

The second analysis was made upon a specimen from a different part of the seam.

Australian Agricultural Company's Mine, Newcastle.

No. 2. Very similar to the Waratah coal, but a shade less bright. Breaks into irregular cuboidal fragments. Does not soil the fingers. Contains films of mineral charcoal.

Specific gravity, 1·297.

Proximate Analysis.

Moisture	2·20	
Volatile hydrocarbons	33·60	
Fixed carbon	57·52	Coke, 62·87 per cent.
Ash	5·35	
Sulphur	1·33	
	100·00	

Coke.—A good firm coke; very large cauliflower-like excrescences.
Ash.—Heavy, white.
Dried at 100° C.

Ultimate Analysis.

Carbon	78·76
Hydrogen	6·34
Oxygen	7·28
Sulphur	1·36
Nitrogen	·79
Ash	5·47
	100·00

Calculated calorific intensity, 8,235.

By experiments with the calorimeter, 1 lb. of this coal would convert 12·92 lbs. of water into steam.

Analysis of Ash.

Silica	50·05
Alumina	34·90
Iron sesquioxide	13·81
Manganese	traces
Lime	·56
Magnesia	·00
Potash	·19
Soda	·02
Phosphoric acid	absent
Sulphuric ,,	1·06
	100·59

No. 3. From the same mine. Examined by W. Skey, *Trans.*, N.Z. Inst., 1871, p. 150.

Proximate Analysis.

Moisture	1·42
Volatile matter	27·25
Fixed carbon	61·21
Sulphur	1·02
Ash	8·80
	99·70

No. 4. Another specimen from the same mine.
Specific gravity, 1·286.

Proximate Analysis.

Water	1·65
Volatile hydrocarbons	35·45
Fixed carbon	57·84
Ash	4·44
Sulphur	0·62
	100·00

Coke.—63·28 per cent.
Ash.—Reddish.

Analysis of Ash.

Alumina	22·84	Soluble in acid, 43·25.
Ferric oxide	15·20	
Lime	1·98	
Magnesia	traces	
Sulphuric oxide	·97	
Phosphoric ,,	2·26	
Alumina	3·45	Insoluble in acid, 56·55.
Ferric oxide	traces	
Silica	53·10	
Undetermined and loss	·20	
	100·00	

Analyses of samples of ash from the roof and floor of the A. A. Company's seam, by W. A. Dixon, F.I.C. :—

No. 5. Roof of galley way.

Percentage of organic matter and water, 9·97.

Analysis of Residue.

Alumina	6·68	Soluble in acid, 11·81.
Ferric oxide	2·77	
Lime	·42	
Magnesia	1·32	
Sulphuric oxide	·21	
Phosphoric „	·41	
Chlorine	traces	
Alumina	12·31	Insoluble in acid, 87·87.
Silica	75·56	
Undetermined and loss	·32	
	100·00	

No. 6. Roof of old No. 1 way.

Percentage of organic matter, 7·70.

Analysis of Residue.

Alumina, Ferric oxide	11·89
Lime	1·61
Magnesia	·93
Phosphoric oxide	·37
Undetermined and loss	·47
Insoluble	84·73
	100·00

No. 7. Floor of galley way.

Percentage of organic matter and water, 30·95.

Analysis of Residue.

Alumina	8·26	Soluble in acid, 11·54.
Ferric oxide	2·21	
Lime	·42	
Phosphoric oxide	·65	
Alumina	13·58	Insoluble in acid, 88·70.
Silica	75·12	
	100·24	

No. 8. Floor of old No. 1 way.

Percentage of organic matter and water, 4·30.

Analysis of Residue.

Alumina	4·88	Soluble in acid, 8·72.
Ferric oxide	2·84	
Lime	·53	
Magnesia	·31	
Phosphoric oxide	·16	
Alumina	12·43	Insoluble in acid, 91·16.
Silica	78·73	
Undetermined and loss	·12	
	100·00	

CARDIFF MINE, LAKE MACQUARIE.

No. 9. A bright, firm, and compact looking anthracitic coal; when struck emits a clear ringing sound, very unlike the dull sound given out by soft and friable varieties of coal. This specimen came from a depth of 434 feet.

Across the joints and planes of stratification it breaks with a somewhat splintery and conchoidal fracture.

Tough, and does not yield readily to pressure.

Does not soil the fingers; no mother-of-coal or mineral charcoal observed. When ignited, decrepitates somewhat, and burns with but a small amount of flame.

A few scattered grains of pyrites were observed in the sample, but the total amount of sulphur present, as shown by the following statement of percentage composition, is below the average:—

Proximate Analysis.

Hygroscopic moisture	1·853
Volatile matter	43·354
Sulphur	·348
Fixed carbon	49·486
Ash	4·944
	99·985

Coke.—54·430 per cent., bright in lustre, and fairly well swollen up.

Ash.—Grey, loose; contains traces of copper.

Ultimate Analysis.

	Inclusive of moisture.	Exclusive of moisture.
Carbon	80·727	82·251
Hydrogen	4·303	4·384
Oxygen	6·816	6·945
Nitrogen	1·009	1·028
Sulphur	·348	0·354
Ash	4·944	5·038
Hygroscopic moisture	1·853	....
	100·000	100·000

Specific gravity, 1·286.

The calorific intensity calculated from the above results is 7,857 units.

Analysis of Ash.

Silica	38·360
Copper	trace
Alumina	35·575
Iron sesquioxide	9·278
Manganese protoxide	2·606
Lime	8·050
Magnesia	1·080
Potash	·593
Soda	2·259
Phosphoric acid	·240
Sulphuric ,,	2·255
	100·296

The presence of copper is rather an unusual occurrence in coal ashes; the copper probably existed as copper pyrites. An examination for gold was made upon this ash, but without success; the ash from some 30 or 40 lbs. weight of coal was tested.

CLARENCE RIVER.

Analysis of Ash.

No. 10. Percentage of ash in coal, 8·75 ; colour, grey.

Alumina	22·78	Soluble in acid, 29·70.
Ferric oxide	4·01	
Lime	1·26	
Magnesia	·48	
Sulphuric oxide	·21	
Phosphoric ,,	·96	
Alumina	5·13	Insoluble in acid, 70·25.
Silica	65·12	
Undetermined and loss	·05	
	100·00	

FERNDALE COLLIERY, Tighe's Hill.

No. 11. Specific gravity, 1·296.

Proximate Analysis.

Water	2.10
Volatile hydrocarbons	36·22
Fixed carbon	57·24
Ash	3·84
Sulphur	·60
	100·00

Coke.—61·08 per cent.
Ash.—Buff coloured.

Analysis of Ash

Alumina	23·24	Soluble in acid, 38·96
Ferric oxide	9·21	
Lime	2·41	
Magnesia	2·11	
Sulphuric oxide	·74	
Phosphoric ,,	1·25	
Alumina	6·42	Insoluble in acid, 61·15.
Ferric oxide	3·44	
Lime	·24	
Magnesia	·23	
Silica	50·82	
	100·11	

GRETA.

No. 12. In appearance very similar to the Waratah coal, but with less mother-of-coal. Does not soil the fingers ; streaky appearance. Fracture conchoidal across the layers.

Specific gravity, 1·287.

Proximate Analysis.

Moisture	2·25	
Volatile hydrocarbons	39·21	
Fixed carbon	54·41	Coke, 57·13 per cent.
Ash	2·72	
Sulphur	1·41	
	100·00	

Coke.—Good, firm, not quite so bright as the former, but rougher in the grain and more swollen up.

Ash.—Loose, buff coloured.

Dried at 100° C.

Ultimate Analysis.

Carbon	78·41
Hydrogen	6·60
Oxygen	9·34
Sulphur	1·44
Nitrogen	1·43
Ash	2·78
	100·00

Calculated calorific intensity, 8,208.

According to the experiments with the calorimeter 1 lb. of this coal would convert 31·21 lbs. of water into steam.

Analysis of Ash.

Silica	48·14
Alumina	39·99
Iron sesquioxide	4·40
Manganese	absent
Lime	5·95
Magnesia	traces
Potash	·82
Soda	·19
Phosphoric acid	trace
Sulphuric ,,	·77
	100·26

Lake Macquarie.

No. 13. Bright and semi-bituminous. In steaming power it would lie between the ordinary Newcastle coal and those of the Illawarra district.

Specific gravity, 1·340.

Proximate Analysis.

Volatile hydrocarbons	31·93
Fixed carbon	54·66
Ash	8·82
Sulphur	·94
Moisture	3·65
	100·00

Coke, 63·48 per cent.; dense, hard, and fairly bright.

The ash was white and loose.

No. 14. A bright bituminous, rather tender, coal.

Specific gravity, 1·374.

Proximate Analysis.

Water	2·31
Volatile hydrocarbons	31·95
Fixed carbon	53·88
Ash	11·12
Sulphur	·74
	100·00

The coke produced was hard and lustrous.

The ash was greyish white.

Minmi Colliery, Newcastle.

No. 15. Bituminous, bright, with a few narrow dull streaks.
Specific gravity, 1·28.

Proximate Analysis.

Moisture	2·59
Volatile hydrocarbons	33·87
Fixed carbon	56·49
Ash	5·61
Sulphur	1·44
	100·00

Coke.—62·10. Coke bright, dense, with fused appearance, little swollen.
Ash.—Reddish, somewhat fusible.

Newcastle Coal Company, Glebe, Newcastle.

No. 16. Specific gravity, 1·283.

Proximate Analysis.

Water	2·14
Volatile hydrocarbons	33·36
Fixed carbon	59·16
Ash	4·76
Sulphur	·58
	100·00

Coke.—63·92 per cent.
Ash.—Buff coloured.

Analysis of Ash.

Alumina	27·21	Soluble in acid, 43·30.
Ferric oxide	11·11	
Lime	1·46	
Magnesia	1·56	
Sulphuric oxide	·72	
Phosphoric ,,	1·24	
Alumina	6·51	Insoluble in acid, 56·34
Ferric oxide	3·02	
Lime	·61	
Magnesia	·63	
Silica	45·57	
Undetermined and loss	·36	
	100·00	

New Lambton Mine.

No. 17. Specific gravity, 1·291.

Proximate Analysis.

Water	2·61
Volatile hydrocarbons	30·62
Fixed carbon	59·56
Ash	6·72
Sulphur	·49
	100·00

Coke.—66·28 per cent.
Ash.—Reddish coloured.

Analysis of Ash.

Alumina	15·00	Soluble in acid, 38·98.
Ferric oxide	17·72	
Lime	2·26	
Magnesia	2·72	
Phosphoric oxide	1·28	
Alumina	5·56	Insoluble in acid, 61·10.
Ferric oxide	2·16	
Lime	·69	
Magnesia	·37	
Silica	52·32	
	100·08	

PLATTSBURG.

No. 18. Coal from the Co-operative Mine, Plattsburg.
Specific gravity, 1·310.

Proximate Analysis.

Water	2·45
Volatile hydrocarbons	34·38
Fixed carbon	58·24
Ash	4·20
Sulphur	·73
	100·00

Coke.—62·44 per cent.
Ash.—Reddish.

Analysis of Ash.

Alumina	23·34	Soluble in acid, 40·43.
Ferric oxide	9·33	
Lime	3·71	
Magnesia	1·99	
Sulphuric oxide	·72	
Phosphoric ,,	1·34	
Alumina	5·90	Insoluble in acid, 58·88.
Ferric oxide	3·17	
Magnesia	·49	
Silica	49·32	
Undetermined and loss	.69	
	100·00	

REDHEAD COAL COMPANY.

No. 19. Specific gravity, 1·325.

Proximate Analysis.

Water	2·09
Volatile hydrocarbons	33·48
Fixed carbon	57·04
Ash	6·84
Sulphur	·55
	100·00

Coke.—63·88 per cent.
Ash.—Grey coloured.

Analysis of Ash.

Alumina	13·59	Soluble in acid, 23·17.
Ferric oxide	4·74	
Lime	1·96	
Magnesia	·71	
Sulphuric oxide	·45	
Phosphoric ,,	1·72	
Alumina	5·03	Insoluble in acid, 76·65.
Ferric oxide	1·97	
Silica	69·65	
Undetermined and loss	·18	
	100.00	

RIX CREEK, Singleton.

No. 20. Coal bright, but rather tender; slightly coking. Analysed by Mr. Latta.

Proximate Analysis.

Water	2·08
Volatile hydrocarbons	37·00
Fixed carbon	54·00
Ash	5·06
Sulphur	0·51
	98·65

Coke.—59·06.

RUSSELL'S MINE.

No. 21. Made up of alternate bright and dull laminæ, which merge one into the other irregularly, giving the coal a streaky appearance quite distinct from the laminated appearance of a coal made up of well defined bright and dull layers. The bright layers have a very brilliant pitchy lustre. Fracture somewhat conchoidal. Does not soil the fingers.

Specific gravity, 1·274.

Proximate Analysis.

Moisture	1·85	
Volatile hydrocarbons	44·09	
Fixed carbon	49·95	Coke, 52·65 per cent.
Ash	2·70	
Sulphur	1·41	
	100·00	

Coke.—Good, firm, bright silvery lustre, with cauliflower-like excrescenses.
Ash.—Loose, colour red, but paler than the Waratah coal ash.
Dried at 100° C.

Ultimate Analysis.

Carbon	77·37
Hydrogen	6·48
Oxygen	10·46
Sulphur	1·43
Nitrogen	1·51
Ash	2·75
	100·00

Calculated calorific intensity, 8,034.

By experiment with the calorimeter, 1 lb. of this coal would convert 13·21 lbs. of water into steam.

Analysis of Ash.

Silica	44·30
Alumina	38·65
Iron sesquioxide	7·85
Manganese	absent
Lime	5·05
Magnesia	·49
Potash	1·37
Soda	·01
Phosphoric acid	absent
Sulphuric acid	1·84
Loss	·44
	100·00

Teralba, near Newcastle

No. 22. Semi-bituminous. Bright, with small conchoidal fracture, stained with oxide of iron.

Specific gravity, 1·35.

Proximate Analysis.

Moisture	4·65
Volatile hydrocarbons	32·84
Fixed carbon	52·68
Ash	8·16
Sulphur	1·67
	100·00

Coke.—60·84. Coke swollen, fairly bright, with small excresences, showed distinct prismatic fracture.

Ash.—Reddish and somewhat friable.

No. 23. A second specimen from the same place was for the most part bituminous, bright, with a few narrow dull layers.

Specific gravity, 1·29.

Proximate Analysis.

Moisture	3·81
Volatile hydrocarbons	30·22
Fixed carbon	54·44
Ash	8·52
Sulphur	3·01
	100·00

Coke.—62·96. Coke bright and lustrous, very little swollen, dense, splits readily.

Ash.—Grey, not easily friable.

Wallsend, Newcastle.

No. 24. A bright coal; laminated structure well marked; breaks into irregular cuboidal fragments. Does not soil the fingers readily. Contains a little fibrous mineral charcoal, or mother-of-coal.

Specific gravity, 1·333.

Proximate Analysis.

Moisture	2·75	
Volatile hydrocarbons	34·17	
Fixed carbon	57·22	} Coke, 61·86 per cent.
Ash	4·64	}
Sulphur	1·22	
	100·00	

Coke.—Much the same as from the Greta coal, but with large cauliflower-like excrescences.

Ash.—Of a pinkish shade, being white mixed with reddish particles.

Dried at 100° C.

Ultimate Analysis.

Carbon	79·96
Hydrogen	6·26
Oxygen	7·08
Sulphur	1·25
Nitrogen	·68
Ash	4·77
	100·00

Calculated calorific intensity, 8,323.

According to experiments with the calorimeter, 1 lb. of this coal would convert 13·21 lbs. of water into steam.

Analysis of Ash.

Silica	39·30
Alumina	25·24
Iron sesquioxide	26·02
Manganese	1·03
Lime	4·35
Magnesia	·30
Potash	traces
Soda	traces
Phosphoric acid	·12
Sulphuric ,,	4·51
	100·87

No. 25. Another sample from the same mine.

Specific gravity, 1·347.

Proximate Analysis.

Water	2·29
Volatile hydrocarbons	34·21
Fixed carbon	58·60
Ash	4·28
Sulphur	·62
	100·00

Coke.—62·88 per cent.

Ash.—Red.

Analysis of Ash.

Alumina	22·25	Soluble in acid, 39·78.
Ferric oxide	11·20	
Lime	3·05	
Magnesia	1·31	
Sulphuric oxide	·83	
Phosphoric ,,	1·14	
Alumina	6·48	Insoluble in acid, 60·73.
Ferric oxide	3·31	
Lime	·32	
Magnesia	·41	
Silica	50·21	
	100·51	

Waratah Colliery.

No. 26. A good, firm, bright coal, with well-marked lines of lamination, bright layers preponderate. Fracture fairly even, breaking into cuboidal masses. Layers of fibrous "mineral charcoal" or "mother-of-coal" in between the bright layers; these are also to be observed in nearly all the other coals. The coal from this mine is sometimes beautifully iridescent.

Specific gravity, 1·303.

Proximate Analysis.

Moisture	2·21	
Volatile hydrocarbons	36·70	
Fixed carbon	55·82	Coke, 59·97 per cent
Ash	4·15	
Sulphur	1·12	
	100·00	

Coke.—Good, firm, bright and silvery lustre, well swollen up, with small cauliflower-like excrescenses.

Ash.—Loose and flocculent, reddish colour.

Dried at 100° C.

Ultimate Analysis.

Carbon	81·06
Hydrogen	5·81
Oxygen	6·52
Sulphur	1·14
Nitrogen	1.23
Ash	4·24
	100·00

The calorific intensity calculated from the above is 8,271 units. According to experiments with the calorimeter 1 lb. of this coal would convert 14·3 lbs. of water into steam.

Analysis of Ash.

Silica	47·30
Alumina	35·58
Iron sesquioxide	9·67
Manganese	absent
Lime	4·95
Magnesia	·30
Potash	1·92
Soda	·05
Phosphoric acid	trace
Sulphuric acid	1·20
	100·97

No. 27. The Waratah Coal Company's old tunnel at Waratah.

Specific gravity, 1·293.

Proximate Analysis.

Water	2·45
Volatile hydrocarbons	38·16
Fixed carbons	54·12
Ash	4·64
Sulphur	·63
	100·00

Coke.—58·76 per cent.

Ash.—Buff colour.

Analysis of Ash.

Alumina	22·31	Soluble in acid, 36·81.
Ferric oxide	8·11	
Lime	2·41	
Magnesia	·98	
Sulphuric oxide	·71	
Phosphoric oxide	2·29	
Alumina	4·59	Insoluble in acid, 63·07.
Ferric oxide	2·31	
Silica	56·17	
Undetermined and loss	·12	
	100·00	

No. 28. *Nodular Coal.*—A smooth, rounded, nodule of anthracitic coal from the Waratah mine; about 2 inches in diameter, harder than the ordinary coal, in which I understand it was found embedded—the rounded form is apparently not due to attrition or the action of running water, but appears to be of a concretionary nature. Similar anthracitic nodules occur in the Australian Agricultural Company's Mine.

On being struck with a hammer the mass flew to pieces, as if it had been in a state of strain or tension; the fragments were small and showed conchoidal fracture surfaces. I believe that these nodules are sometimes met with of much larger size.

Specific gravity, 1·294.

Dried at 100° C.

Proximate Analysis.

Loss at 100° C.	3·32
Volatile hydrocarbons	32·41
Fixed carbon	62·35
Ash	1·72
Sulphur	·19
	99·99

Ultimate Analysis.

Carbon	83·828
Hydrogen	5·437
Oxygen	8·236
Sulphur	·190
Nitrogen	·530
Ash	1·779
	100·000

It will be noticed that the amount of ash is much less than in the ordinary coal from this mine.

Anthracite.

A splintery anthracite is said to occur at Gordon Brook, in the county of Richmond. As far as I have seen at present, only one of the so-called New South Wales anthracites are really deserving of that name, the others are merely very poor or else baked coals, *i.e.*, coal which has been more or less destroyed by the intrusion of a dyke of some igneous rock.

WESTERN DISTRICT.

The analyses and descriptions of specimens numbered 3, 4, 5, 6, 8, 9, 11, 14, and 15 are by Mr. Dixon.

Bowenfels.

No. 1. Dull lustre, rather strongly laminated; laminæ of bright coal, very thin. Does not soil the fingers. Fracture is in parts large conchoidal.

Specific gravity, 1·399.

Proximate Analysis.

Moisture	2·36
Volatile hydrocarbons	28·35
Fixed carbon	56·54
Ash	11·40
Sulphur	1·35
	100·00

Coke.—Does not cake; only a loose and incoherent black powder left.

Ash.—Heavy, white.

Dried at 100° C.

Ultimate Analysis.

Carbon	70·72
Hydrogen	5·65
Oxygen	9·65
Sulphur	1·38
Nitrogen	·93
Ash	11·67
	100·00

Calculated calorific intensity, 7,245.

According to experiments with the calorimeter 1 lb. of this coal would convert 12·65 lbs. of water into steam.

Analysis of Ash.

Silica	69·15
Alumina	29·69
Iron sesquioxide	·63
Manganese	traces
Lime	·25
Magnesia	trace
Potash	·36
Soda	·32
Phosphoric acid (P_2O_5)	·09
Sulphuric acid (SO_3)	·22
	100·71

ESKBANK.

No. 2. A good compact coal; soils the fingers; lustre dull; laminæ not well defined.

Specific gravity, 1·335.

Proximate Analysis.

Moisture	2·00	
Volatile hydrocarbons	33·55	
Fixed carbon	49·97	Coke, 62·88 per cent.
Ash	12·91	
Sulphur	1·57	
	100·00	

Coke.—Fair, but rather tender.

Ash.—Brilliant white colour.

Dried at 100° C.

Ultimate Analysis.

Carbon	72·30
Hydrogen	5·43
Oxygen	6·65
Sulphur	1·60
Nitrogen	·85
Ash	13·17
	100·00

Calculated calorific intensity, 7·426.

By experiment with the calorimeter 1 lb. of this coal would convert 12·65 lbs. of water into steam.

Analysis of Ash.

Silica	62·15
Alumina	29·43
Iron sesquioxide	1·20
Manganese	traces
Lime	1·35
Magnesia	1·73
Potash	2·10
Soda	·19
Phosphoric acid	·05
Sulphuric ,,	1·12
Loss	·68
	100·00

No. 3. Specific gravity, 1·329.

Proximate Analysis.

Water	2·70
Volatile hydrocarbons	28·78
Fixed carbon	57·88
Ash	9·88
Sulphur	·76
	100·00

Ash.—Grey.

Analysis of Ash.

Alumina	21·13	Soluble in acid, 24·62
Ferric oxide	1·39	
Lime	·78	
Magnesia	·61	
Sulphuric oxide	·16	
Phosphoric ,,	·55	
Alumina	14·21	Insoluble in acid, 75·23
Magnesia	trace	
Silica	61·02	
Undetermined and loss	·15	
	100·00	

Katoomba.

No. 4. A sample of the whole thickness of a 4-foot seam at Katoomba. It consists of a mixture of a bituminous and splint coal, with bright and dull-coloured pieces.

Specific gravity, 1·343.

Proximate Analysis.

Moisture	2·71
Volatile hydrocarbons	25·31
Fixed carbon	60·90
Ash	10·84
Sulphur	·24
	100·00

The coke is dense, scarcely swollen, but fairly lustrous.

The ash is white.

This is a fairly good coal, the low percentage of sulphur being particularly noteworthy.

Analysis of Ash.

Alumina	35·26	Soluble in acid, 37·10
Ferric oxide	·98	
Lime	traces	
Magnesia	·30	
Phosphoric oxide	·56	
Alumina	3·23	Insoluble in acid, 62·81
Silica	59·58	
Undetermined and loss	·09	
	100·00	

No. 5. A fairly bright and tolerably hard coal, also from Katoomba, from 106 feet in the tunnel. Did not soil the fingers, and showed layers of "mother-of-coal" in places.

Specific gravity, 1·326.

Proximate Analysis.

Moisture	2·90
Volatile hydrocarbons	25·82
Fixed carbon	61·34
Ash	9·26
Sulphur	·68
	100·00

Coke.—70·60 per cent.; only slightly fritted together, dull coloured, with a few bright specks.

Ash.—A greyish white.

No. 6. Other specimens from Katoomba gave the following results:—

Specific gravity, 1·400.

Proximate Analysis.

Water	2·25
Volatile hydrocarbons	26·28
Fixed carbon	60·84
Ash	10·04
Sulphur	·59
	100·00

Ash.—Greyish white.

Lithgow Valley.

No. 7. Has much the appearance of the Vale of Clwydd coal. Does not soil the fingers.

Specific gravity, 1·329.

Proximate Analysis.

Moisture	1·95	
Volatile hydrocarbons	34·18	
Fixed carbon	52·34	Coke, 62·46 per cent.
Ash	10·12	
Sulphur	1·41	
	100·00	

Coke.—Hard, compact, and fairly lustrous.

Ash.—White in colour.

Dried at 100° C.

Ultimate Analysis.

Carbon	69·41
Hydrogen	6·10
Oxygen	11·70
Sulphur	1·44
Nitrogen	1·03
Ash	10·32
	100·00

Calculated calorific intensity, 7,206.

According to experiments with the calorimeter, 1 lb. of this coal would convert 12·10 lbs. of water into steam.

Analysis of Ash.

Silica	59·10
Alumina	38·95
Iron sesquioxide	·40
Manganese	traces
Lime	·85
Magnesia	·30
Potash	traces
Soda	,,
Phosphoric acid (P_2O_5)	·20
Sulphuric acid (SO_3)	·43
	100·23

LITHGOW VALLEY COLLIERY.

No. 8. Specific gravity, 1·340.

Proximate Analysis.

Water	2·24
Volatile hydrocarbons	28·48
Fixed carbon	58·80
Ash	9·68
Sulphur	·80
	100·00

Ash.—Greyish white.

Analysis of Ash.

Alumina	20·24	Soluble in acid, 23·72
Ferric oxide	1·42	
Lime	·74	
Magnesia	·57	
Sulphuric oxide	·11	
Phosphoric ,,	·64	
Alumina	16·02	Insoluble in acid, 76·23
Silica	60·21	
Undetermined and loss	.05	
	100·00	

MUDGEE.

No. 9. Dull, with bright fracture.
Specific gravity, 1·300.

Proximate Analysis.

Moisture	1·70	
Volatile hydrocarbons	36·42	
Fixed carbon	51·48	Coke, 61·24
Ash	9·76	
Sulphur	·64	
	100·00	

Coke.—Strong and fairly bright.
Ash.—Greyish white and bulky.

VALE OF CLYWDD.

No. 10. A compact coal; rather bright on the whole, the bright layers being fairly numerous; fracture irregular; a fresh surface; does not soil the fingers.

Specific gravity, 1·323.

Proximate Analysis.

Moisture	2·10	
Volatile hydrocarbons	33·35	
Fixed carbon	53·38	Coke, 63·18 per cent.
Ash	9·80	
Sulphur	1·37	
	100·00	

Coke.—Hard, compact, and fairly lustrous.
Ash.—Of a very feeble grey tint.
Dried at 100° C.

Ultimate Analysis.

Carbon	69·86
Hydrogen	5·82
Oxygen	11·89
Sulphur	1·40
Nitrogen	1·02
Ash	10·01
	100·00

Calculated calorific intensity, 7,138.

According to experiments with the calorimeter, 1 lb. of this coal would convert 12·10 lbs. of water into steam.

Analysis of Ash.

Silica	59·55
Alumina	37·35
Iron sesquioxide	2·00
Manganese	traces
Lime	·53
Magnesia	traces
Potash	traces
Soda	traces
Phosphoric acid	traces
Sulphuric ,, (SO_3)	·39
Loss	·18
	100·00

No. 11. Specific gravity, 1·328.

Proximate Analysis.

Water	2·15
Volatile hydrocarbons	35·02
Fixed carbons	52·36
Ash	9·72
Sulphur	·75
	100·00

Ash.—Grey.

Analysis of Ash.

Alumina	22·91	Soluble in acid, 26·03.
Ferric oxide	1·55	
Lime	·81	
Magnesia	traces	
Sulphuric oxide	·17	
Phosphoric ,,	·59	
Alumina	14·55	Insoluble in acid, 73·85.
Ferric oxide	traces	
Magnesia	1·05	
Silica	58·25	
Undetermined and loss	·12	
	100·00	

WALLERAWANG.

No. 12. A specimen of the Wallerawang coal, from a seam 17 feet 6 inches thick, gave the following results :—

Proximate Analysis.

Moisture	1·51	
Volatile hydrocarbons	33·24	
Fixed carbon	55·74	Coke=65·24 per cent.
Ash, white	9·50	
	99·99	

Specific gravity = 1·333.

No. 13. A sample from another seam 6 feet 6 inches thick :—

Proximate Analysis.

Moisture	1·95	
Volatile hydrocarbons	27·25	
Fixed carbon	61·86	70·80 per cent. coke
Ash, white	8·94	
	100·00	

Specific gravity = 1·398.

No. 14. "A sample of true splint coal. It was very firm, and contained some layers of mineral charcoal; colour of a dull brownish-black.

"Specific gravity, 1·326.

Proximate Analysis.

Water	3·85
Volatile hydrocarbons	27·69
Fixed carbon	61·56
Ash	6·88
Sulphur	·02
	100·00

"The powdered coal did not form a coke, an incoherent black powder being left. On heating the coal in lumps it leaves a hard coke slightly lustrous, the pieces having the same shape as the original coal, and showing no signs of fusion.

"The ash was grey coloured and bulky, and contained 0·19 per cent. of phosphoric oxide.

"This is a good coal for the purpose to which it is intended to be applied, namely, iron smelting, as it could be used raw with hot blasts, or coked with either hot or cold, and it is sufficiently firm to carry a heavy burden of ore and fluxes. On heating it decrepitates slightly; but this does not interfere with the firmness of the coke obtained from lumps, but the small, from its character, would be useless for coking."

No. 15. "Another sample of coal from the same locality contained dull and bright layers in about equal proportions, the bright parts breaking with a rather large conchoidal fracture considering their thickness. This coal is a bituminous moderately coking coal, and the specimen was of only moderate firmness.

"Specific gravity, 1·327.

Proximate Analysis.

Water	3·10
Volatile hydrocarbons	34·73
Fixed carbon	51·28
Ash	10·36
Sulphur	·53
	100·00

"The coke produced from the powdered coal was scarcely swollen, of moderate brightness, and not very firm. As I have learned, however, that the sample had been exposed to the air for about a year, it is probable that the freshly dug coal would yield a much superior coke to that produced by the specimen analysed.

"The ash was white, very dense, and contained 0·29 per cent. of phosphoric oxide.

"This coal is not so good for iron smelting as the last, as it contains more sulphur; and as a large quantity of it would be required to produce a ton of iron, as it would have to be used coked, more of the obnoxious ingredients would be introduced into the furnace."—W. A. Dixon, F.C.S., *Annual Report of the Mining Department*, Sydney, 1880.

SOUTHERN DISTRICT.

The analyses and descriptions of specimens numbered 1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 19, 21, 22, and 23 are by Mr. Dixon, F.C.S.

No. 1. Atkinson's Mine, Berrima.
Specific gravity, 1·408.

Proximate Analysis.

Water	1·26
Volatile hydrocarbons	26·61
Fixed carbon	62·28
Ash	9·40
Sulphur	·45
	100·00

Coke, 71·68 per cent.
Ash, greyish white.

Analysis of Ash.

Alumina	18·61	Soluble in acid, 24·00.
Ferric oxide	4·68	
Lime	·58	
Sulphuric oxide	·13	
Phosphoric ,,	traces	
Alumina	·82	Insoluble in acid, 75·87
Silica	75·05	
Undetermined and loss	·13	
	100·00	

BERRIMA.

No. 2. A good firm coal, but more tender than the others. The bright layers present in fair proportion.
Specific gravity, 1·364.

Proximate Analysis.

Moisture	1·70	
Volatile hydrocarbons	32·78	
Fixed carbon	53·84	Coke, 64·24 per cent.
Ash	10·40	
Sulphur	1·28	
	100·00	

Coke.—Bright and lustrous; very much swollen up.
Ash.—White.
Dried at 100° C.

Ultimate Analysis.

Carbon	69·92
Hydrogen	4·55
Oxygen	13·09
Sulphur	1·30
Nitrogen	·56
Ash	10·58
	100·00

Calculated calorific intensity, 6,653.

According to experiments with the calorimeter, 1 lb. of this coal would convert 11·82 lbs of water into steam.

Analysis of Ash.

Silica	67·45
Alumina	31·00
Iron sesquioxide	·40
Manganese protoxide	·16
Lime	·15
Potash	·24
Soda	·18
Phosphoric acid	trace
Sulphuric ,, (SO_3)	·06
Loss	·36
	100·00

No 3. Had a laminated structure, with bright layers, and was rather tender, breaking easily in small pieces.

Specific gravity, 1·37.

Proximate Analysis.

Moisture	1·90
Volatile hydrocarbons	21·17
Fixed carbon	57·67
Ash	18·25
Sulphur	1·01
	100·00

Coke.—75·92.

The coke was much swollen up, soft and black coloured, with a few bright specks.

The ash was greyish-white, but from its large amount this coal would only be of value for local purposes.

No. 4. Rather dull, with very thin bright layers, along which it split rapidly.

Yielded a brown powder. Bituminous.

Specific gravity, 1·56.

Proximate Analysis.

Moisture	1·21
Volatile hydrocarbons	19·95
Fixed carbon	41·30
Ash	36·56
Sulphur	·98
	100·00

Coke.—77·86.

Coke much swollen up, and fairly lustrous and hard.

Ash.—White, but so large in quantity as to render the coal of little value.

No. 5. Dull coloured, bright layers entirely absent, gave a dark brown powder, darker than the last.

Specific gravity, 1·51.

Proximate Analysis.

Moisture	1·26
Volatile hydrocarbons	15·61
Fixed carbon	48·34
Ash	33·92
Sulphur	·87
	100·00

Coke.—82·86.

The coke was not much swollen, black coloured, and friable.

Ash.—White, but so large in quantity as to render the coal of little value.

Bulli.

No. 6. The following analysis was made by Mr. Richard Smith, of the Metallurgical Laboratory in the Royal School of Mines, London; to compare it with the others its proximate composition has been calculated from the ultimate analysis.

Specific gravity, 1·471.

Proximate Analysis.

Water	1·03
Volatile hydrocarbons, &c.	23·65
Fixed carbon	61·61
Ash	13·17
Sulphur	·54
	100·00

"The theoretical calorific or evaporative power, that is, the weight of water converted into steam by 1 lb. of the coal, as determined by experiment with the calorimeter, is 12·21 lbs. A second experiment gave a like result.

"Dried at 100° C.

Ultimate Analysis.

Carbon	75·57
Hydrogen	4·70
Oxygen and nitrogen	4·99
Sulphur	0·54
Ash	13·17
Water	1·03
	100·00

"The colour of the ash is reddish white.

"When a portion of the powdered coal is heated in a closed vessel the gases evolved burn with a yellow luminous, somewhat smoky flame, and a slightly lustrous coherent coke is left, which differs little in bulk from the original coal."

No. 7. From the same mine.

Specific gravity, 1·369.

Proximate Analysis.

Water	·65
Volatile hydrocarbons	21·65
Fixed carbon	65·68
Ash	11·28
Sulphur	·74
	100·00

Coke.—76·96 per cent.

Ash.—Grey.

Analysis of Ash.

Alumina	26·84	Soluble in acid, 35·77
Ferric oxide	7·95	
Lime	·67	
Magnesia	traces	
Sulphuric oxide	·31	
Phosphoric ,,	traces	
Alumina	7·60	Insoluble in acid, 64·53
Silica	56·93	
	100·30	

No. 8. Coal from Coal Cliff Mine, near Bulli.
Specific gravity, 1·378.

Proximate Analysis.

Water	·86
Volatile hydrocarbons	18·22
Fixed carbon	69·84
Ash	10·80
Sulphur	·28
	100·00

Coke.—71·68 per cent.
Ash.—Greyish white.

Analysis of Ash.

Alumina	31·56	Soluble in acid, 38·84.
Ferric oxide	5·33	
Lime	·75	
Magnesia	·60	
Sulphuric oxide	·31	
Phosphoric ,,	·29	
Alumina	3·61	Insoluble in acid, 61·02
Ferric oxide	traces	
Silica	57·41	
Undetermined and loss	·14	
	100·00	

JOADJA CREEK

No. 9. Top coal.
Percentage of ash, 6·71.

Analysis of Ash.

Alumina	11·23	Soluble in acid, 24·53.
Ferric oxide	11·55	
Lime	·20	
Magnesia	·63	
Phosphoric oxide	·92	
Alumina	22·15	Insoluble in acid, 71·01
Ferric oxide	traces	
Silica	48·86	
Undetermined and loss	·41	
Alkalies and chlorine	4·05	Soluble in water.
	100·00	

No. 10. Bottom coal.
Percentage of ash, 22·28 ; ash very dense, grey coloured.

Analysis of Ash.

Alumina	20·04	Soluble in acid, 22·96.
Ferric oxide	1·84	
Lime	·28	
Magnesia	·36	
Phosphoric oxide	·44	
Alumina	7·79	Insoluble in acid, 76·42.
Ferric oxide	traces	
Silica	68·63	
Alkalies	0·85	Soluble in water.
	100·23	

No. 11. From Jordan's Crossing, near the above place.

Bituminous, rather dull, and somewhat brittle. The piece sent had a bright band running through the middle, and this band was very tender, breaking with slight pressure into rectangular fragments.

Specific gravity, 1·401.

Proximate Analysis.

Moisture	2·36
Volatile hydrocarbons	28·27
Fixed carbon	51·66
Ash	15·86
Sulphur	1·85
	100·00

Coke.—67·52.

Coke dense, hard, not much swollen, and having a silvery lustre.

Ash.—Pure white, aluminous.

MARULAN.

Two samples of weathered, dirty looking coals, of high specific gravity, from near Hanging Rock, Marulan, were found to contain 28·09 per cent. and 39·76 per cent. of ash respectively, and were deemed unworthy of a more detailed examination.

No. 12. A rather dull coloured coal, having somewhat the character of splint, from Hanging Rock, near Marulan.

Specific gravity, 1·341.

Proximate Analysis.

Water	2·25
Volatile hydrocarbons	26·14
Fixed carbon	57·68
Ash	13·52
Sulphur	·41
	100·00

This coal scarcely forms a true coke, a very slight coherent black mass being left ; but as the specimen was evidently taken from an outcrop, were it would be more or less weathered, this character would probably be altered on opening out the seam.

The ash was greyish white.

No. 13. This was a rather dull coloured coal, somewhat stained by oxide of iron, rather tender, and containing a considerable quantity of mineral charcoal, from the same locality as the last.

Specific gravity, 1·536.

Proximate Analysis.

Water	2·41
Volatile hydrocarbons	24·26
Fixed carbon	53·66
Ash	18·95
Sulphur	·72
	100·00

The coke produced was fairly bright and hard, and was covered with bright silvery excrescences.

The ash was white.

No. 14. A moderately bright, but firm coal, from the same seam as last.

Specific gravity, 1·398.

Proximate Analysis.

Water	1·97
Volatile hydrocarbons	31·77
Fixed carbon	55·64
Ash	9·94
Sulphur	·68
	100·00

The coke and ash were similar to the last.

No. 15. This was a dull coloured splint-like coal, of moderate firmness, forming another band in the seam from which the last two were obtained.

Specific gravity, 1,404.

Proximate Analysis.

Water	2·13
Volatile hydrocarbons	28·75
Fixed carbon	59·00
Ash	9·55
Sulphur	·57
	100·00

The coke obtained was dull coloured and soft.

The ash was greyish white.

MITTAGONG.

No. 16. From a newly opened seam.

Contained dull and bright layers, in about equal proportions; slightly soils the fingers. The bright lines of fracture were marked by numerous lens-shaped cavities 0·05 to 0·1 inch in greater diameter, generally filled with a brownish pulverulent carbonaceous matter. These were apparently the impressions, and remains of seeds, and they showed traces of a dense cortical layer. The brown matter on heating glowed, emitted a smoky odour, and burned away completely.

Specific gravity, 1·486.

Proximate Analysis.

Moisture	2·91
Volatile hydrocarbons	8·92
Fixed carbon	62·24
Ash	24·74
Sulphur	1·19
	100·00

This coal did not produce a true coke, a loose, incoherent black powder being left.

Ash.—Greyish white, but much too large in amount.

MOUNT KEIRA.

No. 17. Possesses much the same characters as the last, only soils the fingers rather more readily.

Specific gravity, 1·379.

Proximate Analysis.

Moisture	1·15	
Volatile hydrocarbons	23·51	
Fixed carbon	64·65	Coke, 74·35 per cent.
Ash	9·70	
Sulphur	·99	
	100·00	

Coke.—Hard, fairly lustrous, and much swollen up, with cauliflower-like excrescences.

Ash.—Loose, brilliant white colour.

Dried at 100° C.

Ultimate Analysis.

Carbon	78·82
Hydrogen	5·17
Oxygen	3·87
Sulphur	1·00
Nitrogen	1·33
Ash	9·81
	100·00

Calculated calorific intensity, 7,983.

According to experiments with the calorimeter, 1 lb. of this coal would convert 12·92 lbs. of water into steam.

Analysis of Ash.

Silica	53·00
Alumina	46.88
Iron sesquioxide	traces
Manganese	absent
Lime	traces
Magnesia	traces
Potash } Soda }	·10
Phosphoric acid	absent
Sulphuric ,,	absent
Loss	·02
	100·00

This ash practically answers to the formula Al_2O_3, 2 SiO_2.

MOUNT KEMBLA.

No. 18. A coal of medium brightness, with laminated structure, breaking with a granular surface in places; splits readily along the planes of lamination. The bright layers are tender, and break into small pieces with conchoidal surfaces.

Specific gravity, 1·363.

Proximate Analysis.

Moisture	1·50
Volatile hydrocarbons	19·74
Fixed carbon	67·18
Ash	10·72
Sulphur	·86
	100·00

Coke.—Coal does not cake, therefore no true coke formed—a dull black fritted mass only is left.

Ash.—Brilliant white colour.

Dried at 100° C.

Ultimate Analysis.

Carbon	80·67
Hydrogen	5·30
Oxygen	1·58
Sulphur	·87
Nitrogen	·70
Ash	10·88
	100·00

Calculated calorific intensity, 8,276.

According to experiments with the calorimeter, 1 lb. of this coal would convert 13·21 lbs. of water into steam.

Analysis of Ash.

Silica	52·57
Alumina	43·55
Iron sesquioxide	·95
Manganese	traces
Lime	1·35
Magnesia	·60
Potash	·15
Soda	·27
Phosphoric acid (P_2O_5)	·17
Sulphuric acid (SO_3)	·79
	100·40

No. 19. Coal from the Mount Pleasant Mine of the Illawarra Coal Company, Wollongong.

Specific gravity, 1·354.

Proximate Analysis.

Water	·70
Volatile hydrocarbons	22·04
Fixed carbon	68·08
Ash	8·76
Sulphur	·42
	100·00

Coke.—76·84 per cent.

Ash.—Grey.

Analysis of Ash.

Alumina	34·07	Soluble in acid, 41·75
Ferric oxide	6·03	
Lime	·82	
Magnesia	traces	
Sulphuric oxide	·51	
Phosphoric ,,	·32	
Alumina	6·50	Insoluble in acid, 57·69
Ferric oxide	traces	
Silica	51·19	
Undetermined and loss	·56	
	100·00	

NATTAI.

No. 20. A hard, compact, lustrous anthracitic coal, slightly stained in parts with iron oxide, which looks as if it had been derived from the decomposition of iron pyrites; but, contrary to what was expected, hardly a trace of sulphur was found to be present. Any pyrites which the coal may have originally contained must have practically undergone complete decomposition and removal.

Anthracitic coals generally occur in places where the coal measures have been more or less disturbed or changed, *i.e.*, in places where there is considerable contortion of the strata, and also where there are intrusive metamorphic or igneous rocks. Probably this particular specimen came from a portion of a seam which had been affected by one of the intrusions occurring in the district.

Proximate Analysis.

Loss at 100° C.	3·287	
Volatile hydrocarbons	4·337	
Fixed carbon	87·959	Coke, 92·375.
Ash	4·416	
Sulphur	trace	
	99·999	

Ultimate Analysis.

Dried at 100° C.

Carbon	91·246
Hydrogen	3·605
Oxygen and nitrogen	0·583
Sulphur	trace
Ash	4·566
	100·000

Calculated calorific intensity, 8,590.

The ash of this coal was not analysed.

Coal containing pea-iron ore is abundant at Nattai. Another coal, from near to Nattai, is very brilliant in lustre, and breaks with a pitchy lustrous conchoidal fracture like albertite; it is also marked by the presence of thick layers of "mother-of-coal" or fibrous mineral charcoal.

No. 21. A rather dull coloured coal, stained with ferric oxide, in some places iridescent. It was rather tender, and stained the fingers; fracture of the bright layers minutely conchoidal. From the Southern District.

Specific gravity, 1·307.

Proximate Analysis.

Moisture	·75
Volatile hydrocarbons	23·37
Fixed carbon	65·81
Ash	8·19
Sulphur	1·88
	100·00

Coke.—74 per cent.; bright and dense.
Ash.—Greyish.

WINGECARRIBEE RIVER.

No. 22. From near Berrima.

A hard bituminous coal, generally bright, but with reddish incrustation, the bright pieces breaking with decided conchoidal fracture.

Specific gravity, 1·355.

Proximate Analysis.

Moisture	1·41
Volatile hydrocarbons	30·20
Fixed carbon	53·15
Ash	13·46
Sulphur	1·78
	100·00

Coke.—66·61.
Coke hard, slightly swollen, and fairly lustrous.
Ash.—White.

WOLLONGONG.

No. 23. Coal from Osborne-Wallsend Colliery.
Specific gravity, 1·404.

Proximate Analysis.

Water	1·19
Volatile hydrocarbons	21·07
Fixed carbon	66·92
Ash	10·20
Sulphur	·62
	100·00

Coke.—77·12 per cent.
Ash.—Grey.

Analysis of Ash.

Alumina	30·31	Soluble in acid, 40·51
Ferric oxide	8·68	
Lime	1·18	
Magnesia	traces	
Sulphuric oxide	·34	
Phosphoric ,,	traces	
Alumina	5·24	Insoluble in acid, 60·00
Ferric oxide	trace	
Silica	54·76	
	100·51	

TABLE I.

Composition of Coals.

Proximate Analyses.

Northern District.

Name of Colliery.	Water.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur	Specific Gravity.	Coke.	Analyst.
Russell's	1·85	44·09	49·95	2·70	1·41	1·274	52·65	Liversidge.
Greta	2·25	39·21	54·41	2·72	1·41	1·287	57·13	,,
Ferndale Colliery, Newcastle	2·10	36·22	57·24	3·84	·60	1·296	61·08	Dixon.
Waratah ,, near Newcastle	2·21	36·70	55·82	4·15	1·12	1·303	59·97	Liversidge.
,, ,, ,,	2·45	38·16	54·12	4·64	·63	1·293	58·76	Dixon.
Co-operative Colliery, Plattsburg	2·45	34·38	58·24	4·20	·73	1·310	62·44	,,
Newcastle Wallsend Company	2·29	34·21	58·60	4·28	·62	1·347	62·88	,,
,,	2·75	34·17	57·22	4·64	1·22	1·333	61·86	Liversidge.
Australian Agricultural Company	1·65	35·45	57·84	4·44	·62	1·286	63·28	Dixon.
,,	2·20	33·60	57·52	5·35	1·33	1·297	62·87	Liversidge.
Newcastle Coal-mining Co., Glebe	2·14	33·36	59·16	4·76	·58	1·283	63·92	Dixon.
Cardiff Mine, Lake Macquarie	1·85	43·35	49·49	4·94	·34	1·286	54·43	Liversidge.
Rix Creek, Singleton	2·80	37·00	54·00	5·06	·51	......	59·06	Latta.
Minmi Colliery, Hexham	2·59	33·87	56·49	5·61	1·44	1·280	62·10	Dixon.
New Lambton Colliery, nr. Newcastle	2·61	30·62	59·56	6·72	·49	1·291	66·28	,,
Redhead Coal Company	2·09	33·48	57·04	6·84	·55	1·325	63·88	,,
Anvil Creek	1·74	41·10	47·90	7·80	1·46	1·323	55·70	Liversidge.
Teralba, near Newcastle	4·65	32·84	52·68	8·16	1·67	1·350	60·84	Dixon.
,, ,,	3·81	30·22	54·44	8·52	3·01	1·290	62·96	,,
Lake Macquarie, near Newcastle	3·65	31·93	54·66	8·82	·94	1·340	63·48	,,
Mean	2·47	35·70	55·32	5·41	1·3	1·305	60·78	
Western District.								
Wallerawang	3·85	27·69	61·56	6·88	·02	1·326	none	Dixon.
,,	1·95	27·25	61·86	8·94	......	1·398	70·10	Liversidge.
,,	1·51	33·24	55·74	9·50	......	1·333	65·24	,,
,,	3·10	34·73	51·28	10·36	·53	1·327	61·64	Dixon.
Katoomba	2·90	25·82	61·34	9·26	·68	1·326	70·60	,,
,,	2·25	26·28	60·84	10·04	·57	1·400	none	,,
,,	2·71	25·31	60·90	10·84	·24	1·343	71·74	,,
Lithgow Valley	2·24	28·48	58·80	9·68	·80	1·340	none	,,
,,	1·95	34·18	52·34	10·12	1·41	1·329	62·46	Liversidge.
Vale of Clwydd	2·15	35·02	52·36	9·72	·75	1·328	none	Dixon.
,,	2·10	33·35	53·38	9·80	1·37	1·323	63·18	Liversidge.
Rylstone	1·70	36·42	51·48	9·76	·64	1·300	61·24	Dixon.
Eskbank	2·70	28·78	57·88	9·88	·76	1·329	none	,,
,,	2·00	33·55	49·97	12·91	1·57	1·335	62·88	Liversidge.
Bowenfels	2·36	28·35	56·54	11·40	1·35	1·399	none	,,
Mean	2·34	31·65	56·09	9·87	·87	1·342	64·67	
Southern District.								
Nattai	3·28	4·34	87·96	4·41	trace	......	93·37	Liversidge.
No locality	·75	23·37	65·81	8·19	1·88	1·307	74·00	Dixon.
Illawarra Coal Company's Colliery	·70	22·04	68·08	8·76	·42	1·354	76·84	,,
Berrima, Atkinson's Mine	1·26	26·61	62·28	9·40	·45	1·408	71·68	,,
,,	1·70	32·78	53·84	10·40	1·28	1·364	64·24	Liversidge.
Marulan	2·13	28·75	59·00	9·55	·57	1·404	68·55	Dixon.
,,	1·97	31·77	55·64	9·94	·68	1·398	65·58	,,
,,	2·25	26·14	57·68	13·52	·41	1·341	none	,,
Mount Keira	1·15	23·51	64·65	9·70	·99	1·379	74·35	Liversidge.
Osborne Wallsend Col., Wollongong	1·19	21·07	66·92	10·20	·62	1·404	77·12	Dixon.
Coal Cliff Colliery	1·61	19·68	68·08	10·28	·35	1·372	78·36	,,
,,	·86	18·22	69·84	10·80	·28	1·378	80·64	,,
Mount Kembla	1·50	19·74	67·18	10·72	·86	1·363	none	Liversidge.
Bulli Colliery	.65	21·65	65·86	11·28	·74	1·369	76·96	Dixon.
,,	1·03	23·65	61·61	13·17	·54	1·471	74·78	R. Smith.
Mean	1·47	22·89	64·96	10·02	·72	1·394	75·11	

The coals in the foregoing tables are arranged in order, according to the amount of ash present, the first of the series containing the smallest, and the last the largest weight of ash. With a few exceptions—such as the Teralba, Lake Macquarie, Anvil Creek, and the Cardiff Mine it is rather interesting to note that the proportion of fixed carbon increases with the increase in the amount of ash—the proportions of volatile hydrocarbons naturally undergo a corresponding diminution.

Speaking generally, the coals which yield a large percentage of volatile hydrocarbons may be said to be the best adapted for the manufacture of gas.

It will also be at once apparent that the specific gravity in most cases affords a very good indication of the quality of the coal. As a general rule, ordinary coals which possess a high specific gravity contain a large proportion of ash.

Although these tables show decided differences between the coals from the three districts, doubtless the examination of additional specimens will prove that the above means do not quite represent the average composition of the coals. Some of the analyses were necessarily made upon outcrop specimens, and such can hardly be regarded as truly representing the quality of the seams from which they were obtained.

It is noticeable that the quantity of ash yielded by the Western and Southern coals is much greater than is yielded by the Northern ones, also that the specific gravity is higher as a rule.

The ash of Western and Southern coals is white and dense, whereas many of the Northern coals yield ashes of a buff or red tint, which are often quite loose and flocculent.

It is a common opinion that the relative amounts of sulphur present in different coals can be approximately estimated by the redness of the ash—on the supposition that the whole of the sulphur exists in the coal in the form of iron pyrites—but such is not the case; on referring to the analyses on the Northern District coals, it will be seen that some of the coals which left pure white coloured ashes contained the largest amount of sulphur, and that others which left red ashes contained the smallest quantity of sulphur.

Sulphur may be present in coals in various forms—either in combination with iron as pyrites, which is the most common form of all—as sulphuric acid in combination with the inorganic constituents of the coal, such as alumina, lime, magnesia, or potash; or it may even exist in the form of organic compounds.

In order that an opinion may be formed with regard to the coals of New South Wales, it will perhaps not be amiss to compare them with some of those produced in various parts of Great Britain.

In the first place, the proportion of ash in a coal is a matter of the greatest importance; the value of coal as a fuel depends to a great extent upon the smallness of the quantity of non-combustible matter which it contains; if the amount be very large the coal will be perfectly worthless; but for some purposes, as Dr. Percy states,—"A certain amount of inorganic matter in coal is sometimes beneficial in preventing its too rapid combustion in the furnace. On this account a kind of coal called 'brasils,' which occurs in the middle of the Tenyard coal in South Staffordshire, is preferred for reverberatory furnaces by some smelters in Birmingham." * Neither must the quality or chemical composition of the ash be neglected, for if the ashes be easily fusible, as they usually are when a large quantity of iron is present, they tend to "clinker up" the grate and thus cause great waste of heat, and the expenditure of much extra time and labour in stoking.

We have seen that the Northern District coals yield on the average the smallest amount of ash, which is from 2·70 per cent. to 8·82, with an average percentage of 5·41; the Western District coals range from 6·88 to 12·91, and average 9·87 per cent.; and the Southern District coals, omitting the samples which seem to be somewhat exceptional in character, yield from 4·41 to 13·52 per cent., and average 10·02 per cent. ash.

* Percy's "Metallurgy," vol. i., p. 280.

Now English Newcastle (Northumberland) coking coal contains from 0·79 to 2·49 per cent. ash (see Percy's "Metallurgy," vol. i., p. 99), and averages 1·68. The Nottinghamshire contains 3·9 per cent., and coal from Blaina, South Wales, averages 2·63 per cent. English non-coking coals run rather higher; thus South Staffordshire coal varies from 1·55 to 6·44, and South Wales from 1·20 to 7·18; Scotch coals from 1·43 to 6·75; so that as far as the proportion of ash is concerned, some of our Northern coal is quite equal to the Welsh and Scotch coals, and but little inferior to the English Newcastle coal.

A matter to which it is necessary to pay careful attention is the proportion of sulphur present in a coal. The presence of a large amount of this element not only renders the use of the coal unpleasant for domestic purposes, but makes it uselcss for most manufacturing and metallurgical operations.

The quantity of sulphur existing in the New South Wales coals is by no means excessive, and they will in this respect compare not unfavourably with those of other countries.

Percentage of Sulphur.

	Minimum.	Mean.	Maximum.
Northern Coal-fields	·34	1·30	3·01
Western ,, ,,	·02	·87	1·57
Southern ,, ,,	trace	·72	1·88
Newcastle coal (England)*	·55	·97	1·51

The mean percentages of sulphur as given above for the New South Wales coals are probably too high, since, as has already been remarked, some of the samples were doubtless only outcrop specimens from seams not yet properly opened out.

Playfair and De la Beche found during their investigation for the English Government that the mean percentage of sulphur was as follows:—

Welsh coal	1·42	per cent. sulphur.
Derbyshire	1·01	
Lancashire	1·42	
Newcastle	0·94	
Scotland	1·45	

Most of the secondary and tertiary coals, on the other hand, contain a larger proportion of sulphur, usually 2·0 or 3·0 and sometimes as much as even 5·0 or 6·0 per cent.

The Annual Report of the Department of Mines, Sydney, for 1880, contains a very valuable series of tables, prepared by Mr. A. W. Dixon, F.C.S., to show the compositions of the New South Wales coals as compared with those from other parts of the world.

Composition of the Ashes.—In the table showing the percentage composition of the ashes it will be noticeable there are great differences in the amounts of silica, alumina, and of iron sesquioxide. Some of the ashes, however, in the different groups seem to agree fairly well together, and although the samples came from different districts, yet it may be that they are from an extension of the same seam. The composition of the ashes as well as of the coals may help us to correlate the coal seams of the different districts one with the other, *i.e.*, assist in determining their positions in a geological section of the whole of the coal measures as developed in different parts of the Colony. Judging from the composition of the ashes, one would be inclined to say, that not only do certain of the coals in each district come from the same seam, but that the western coals from the Vale of Clwydd and Lithgow Valley belong to the same horizon as the southern coal from Berrima; but much importance cannot be attached to this matter, certainly it would never do to allow the analysis of one specimen only from a given seam, to have much influence, for although a sample of coal may appear to be free from foreign substances and to look perfectly uniform to the eye—in fact appear to be homogeneous throughout—yet on analysis it is nearly always found that the different parts of one and the same piece yield different

* *Vide* Percy's "Metallurgy," vol. i.

proportions of ash, carbon, hydrogen, &c. Hence, if different portions of the same lump vary, we may naturally expect that samples taken from different parts of the seam should also vary. But in spite of minor variations in different specimens of coal from any given seam we find that on the average the coal will have a fairly uniform composition ; to obtain uniform and truly representative samples portions should be taken of the whole thickness of the seam from different parts of the working face. It would be well to take some tons weight of the coal, which should be broken up into pieces of moderate size and well mixed. From this heap portions should then be removed, in radial lines cutting down to the centre, and thrown into a smaller heap of a few hundred-weights ; after this smaller heap has been well mixed portions should be again removed radially and a third time well mixed ; this last could then doubtless be regarded as a true sample and not a mere specimen, as a single lump of coal must necessarily be. Too much care cannot possibly be taken over the collection and preparation of samples.

TABLE II.

Composition of Coal Ashes.

Name of Colliery.	Ash.	Silica.	Alumina.	Iron Sesqui-oxide.	Man-ganese (MnO).	Lime.	Magnesia.	Potash.	Soda.	Phos-phoric Acid.	Sulphuric Acid.	Undeter-mined and Loss.	Analyst.
Northern District.													
Russell's Coal-mine	2·70	44·30	38·65	7·85	..	5·05	·49	1·37	·01	..	1·84	..	Liversidge.
Greta	2·72	48·14	39·99	4·40	..	5·95	trace	·82	·19	trace	·77	..	,,
Ferndale	3·84	50·82	29·66	12·65	..	2·65	2·34	..	..	1·25	·74	..	Dixon.
Waratah	4·15	47·30	35·58	9·67	..	4·95	·30	1·92	·05	trace	·77	..	Liversidge.
,,	4·64	56·17	26·90	10·42	..	2·41	·98	..	..	2·29	·71	·12	Dixon.
Co-operative-Plattsburg	4·20	49·32	29·24	12·50	..	3·71	2·48	..	..	1·34	·72	·69	,,
Newcastle-Wallsend Company	4·28	50·21	28·73	14·51	..	3·37	1·72	..	..	1·14	·83	..	,,
,,	4·64	39·30	25·24	26·02	1·03	4·35	·30	trace	trace	·12	4·51	..	Liversidge.
Australian Agricultural	4·44	53·10	26·29	15·20	..	1·98	traces	..	..	2·26	·97	..	Dixon.
,,	5·35	50·05	34·90	13·81	trace	0·56	..	·19	·02	..	1·06	..	Liversidge.
Newcastle Coal Company	4·76	45·57	33·72	14·13	..	2·07	2·19	..	..	1·24	·72	·36	Dixon.
Cardiff Mine	4·94	38·36	35·57	9·27	2·60	8·05	1·08	·59	2·25	·24	2·25	..	Liversidge.
New Lambton (near Newcastle)	6·72	52·32	20·56	19·88	..	2·95	3·09	..	..	1·28	..	..	Dixon.
Red Head Coal Company	6·84	69·65	18·62	6·71	..	1·96	·71	..	..	1·72	·45	·18	,,
Anvil Creek	7·80	48·70	38·84	2·71	trace	5·20	·70	2·13	·43	trace	..	·85	Liversidge.
,, 2nd specimen	..	50·16	40·50	2·00	trace	4·10	·32	2-02	·12	trace	·56	..	,,
Total	72·02	793·47	502·99	181·73	3·63	59·31	16·70	9·04	3·07	12·88	16·90	..	
Mean	4·50	49·59	31·43	11·36	·23	3·70	1·04	·56	·19	·80	1·05	..	
Southern District.													
Illawarra, Mount Pleasant	8·76	51·19	40·57	6·03	..	·82	traces	..	..	·32	·51	·56	Dixon.
Berrima	9·40	75·05	19·43	4·68	..	·58	..	..	..	traces	·13	·13	,,
,,	10·40	67·45	31·00	·40	·16	·15	..	·24	·18	traces	·06	..	Liversidge.
Mount Keira	9·70	53·00	46·88	trace	..	trace	trace	..	·10	..	..	..	,,
Katoomba	10·04	59·58	38·49	·98	..	traces	·30	..	..	·56	..	·09	Dixon.
Osborne Wallsend	10·20	54·76	35·55	8·68	..	1·18	traces	..	..	traces	·34	..	,,
Mount Kembla	10·72	52·57	43·55	·95	trace	1·35	·60	·15	·27	·17	·79	..	Liversidge.
Coal Cliff	10·80	57·41	35·17	5·33	..	·75	·60	..	..	·29	·31	·14	Dixon.
Bulli	11·28	56·93	34·44	7·95	..	·67	traces	..	..	traces	·31	..	,,
Total	91·30	527·94	325 08	35·09	·16	5·50	1·50	·39	·55	1·34	2·45	..	
Mean	10·14	58·66	36·12	3·89	·02	·61	·17	·4	·6	·15	·27	..	
Western District.													
Lithgow Valley	9·68	60·21	36·26	1·42	..	·74	·57	..	..	·64	·11	·05	Dixon.
,,	10·12	59·10	38·95	·40	trace	·85	·30	trace	trace	·20	·43	..	Liversidge.
Vale of Clwydd	9·72	58·25	37·46	1·55	..	·81	1·05	..	..	·59	·17	·12	Dixon.
,,	9·80	59·55	37·35	2·00	trace	·53	trace	..	trace	trace	·39	..	Liversidge.
Eskbank	9·88	61·02	35·34	1·39	·78	·78	·61	..	.	·55	·16	..	Dixon.
,,	12·91	62·15	29·43	1·20	trace	1·35	1·73	2·10	·19	·05	1·12	..	Liversidge.
Bowenfels	11·40	69·15	29·65	·63	trace	·25	trace	·36	·32	·09	·22	..	,,
Weatherboard	..	83·80	14·43	·40	trace	·35	·95	·32	·12	..	·46	..	,,
Total	73 51	513·23	258·87	8·99	·78	5·66	5·21	2·78	·63	2·12	3·06	..	
Mean	10·50	64·15	32·36	1·12	·09	·70	·65	·35	·08	·26	·38	..	

In the following table the coals are arranged according to their relative calorific intensities, the highest being placed at the top :—

TABLE III.

Ultimate Analyses.

Locality.	Specific Gravity.	Composition per cent. exclusive of water only.						Water per cent.	Coke per cent.	Calorific intensity (calculated).	Water converted into steam by 1 lb. coal with calorimeter.
		Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Sulphur	Ash.				
I. Northern District Coals.											
Wallsend	1·333	79·96	6·26	7·08	0·68	1·25	4·77	2·75	61·86	8323	13·21
Waratah	1·303	81·06	5·81	6·52	1·23	1·14	4·24	2·21	59·97	8271	14·30
A. A. Co., Newcastle	1·297	78·76	6·34	7·28	0·79	1·36	5·47	2·20	62·87	8235	12·92
Greta	1·287	78·41	6·60	9·34	1·43	1·44	2·78	2·25	57·13	8208	13·21
Russell's Mine	1·274	77·37	6·48	10·46	1·51	1·43	2·75	1·85	52·65	8034	13·21
Anvil Creek	1·323	77·15	5·91	6·07	1·46	1·48	7·93	1·74	55·70	8009	12·65
Cardiff Mine	1·286	82·25	4·38	6·95	1·03	0·35	5·04	1·853	54·43	7857	—
The mean	1·300	79·28	5·97	7·67	1·16	1·21	4·71	2·122	57·80	8134	13·25
II. Western District Coals.											
Eskbank	1·335	72·30	5·43	6·65	0·85	1·60	13.17	2·00	62·88	7426	12·65
Bowenfells	1·399	70·72	5·65	9·65	0·93	1·38	11·67	2·36	...	7245	12·65
Lithgow Valley	1·329	69·41	6·10	11·70	1·03	1·44	10·32	1·95	62·46	7206	12·10
Vale of Clwydd	1·323	69·86	5·82	11·89	1·02	1·40	10·01	2·10	63·18	7138	12·10
The mean	1·346	70·57	5·75	9·97	0·96	1·45	11·29	2·10	62·84	7254	12·37
III. Southern District Coals.											
Nattai	...	91·24	3·60	0·59	...	trace	4·56	3·28	92·37	8590	Undet.
Mount Kembla	1·363	80·67	5·30	1·58	0·70	0·87	10·88	1·50	...	8276	13·21
Mount Keira	1·379	78·82	5·17	3·87	1·33	1·00	9·81	1·15	74·35	7983	12·92
Berrima	1·364	69·92	4·55	13·09	0·56	1·30	10·58	1·70	64·24	6653	11·82
Bulli *(R. Smith)*	1·471	76·35	4·75	5·04	...	0·55	13·31	1·03	74·78	...	12·21
The mean	1·394	79·401	4·675	4·833	0·52	0.74	9·829	1·733	76·436	7875	12·54

It is again apparent that the Northern coals as a class are considerably superior to the Southern coals, which in turn are better than those from the Western districts; these differences are shown most plainly in the last two columns, viz., those showing the calculated calorific intensities and the proportions of water converted into steam by 1 lb. of each of the coals when burnt in Thomson's calorimeter.

As a class the Northern coals are brighter and more laminated than the Southern and Western, they yield a larger proportion of volatile hydrocarbons, and are therefore more suitable for making gas, and furnish bright, hard, sonorous cokes of extremely good quality.

The Southern coals are not so bright, and, unlike the Northern, they do not cake in an ordinary open fire, but yield a very good coke when treated in ovens.

The Western coals are of a still drier character and duller appearance; they only coke when freshly raised from the mine.

Both of the latter burn with much less smoke than the rich bituminous Northern coal.

RETURN showing the Quantity and Value of Coal produced in the Colony of New South Wales (from the Annual Reports of the Department of Mines, Sydney).

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Tons.	£		Tons.	£
Prior to 1829	50,000	25,000	1856	189,960	117,906
1829	780	394	1857	210,434	148,158
1830	4,000	1,800	1858	216,397	162,162
1831	5,000	2,000	1859	308,213	204,371
1832	7,143	2,500	1860	368,862	226,493
1833	6,812	2,575	1861	342,067	218,820
1834	8,490	3,750	1862	476,522	305,234
1835	12,392	5,483	1863	433,889	236,230
1836	12,646	5,747	1864	549,012	270,171
1837	16,083	7,828	1865	585,525	274,303
1838	17,220	8,399	1866	774,238	324,049
1839	21,283	10,441	1867	770,012	342,655
1840	30,256	16,498	1868	954,231	417,809
1841	34,841	20,905	1869	919,774	346,146
1842	39,900	23,940	1870	868,564	316,836
1843	23,862	16,222	1871	898,784	316,340
1844	23,118	12,363	1872	1,012,426	396,198
1845	22,324	8,769	1873	1,192,862	665,747
1846	38,965	13,714	1874	1,304,567	790,224
1847	40,732	13,750	1875	1,329,729	819,430
1848	45,447	14,275	1876	1,319,918	803,300
1849	48,516	14,647	1877	1,444,271	858,998
1850	71,216	23,375	1878	1,575,497	920,936
1851	67,610	25,546	1879	1,583,381	950,879
1852	67,404	36,885	1880	1,446,180	625,337
1853	96,809	78,059	1881	1,775,224	603,248
1854	116,642	119,380			
1855	137,076	89,082	Total		12,265,307

CANNEL COAL.—Torbanite or Kerosene Shale.

The name "kerosene shale," commonly applied to this mineral, is not at all appropriate. The substance does not sufficiently possess the properties of a shale, *i.e.*, it has not the characteristic lamellar or platy structure of a shale, but the reverse, being very compact and breaking with large smooth conchoidal surfaces with equal readiness in every direction and without any tendency to follow the planes of stratification. Ordinarily it is almost devoid of all traces of stratification, but occasionally indications can be seen where the mineral is in the form of sufficiently large blocks, or when it is *in situ*, but even then the planes of stratification are mainly rendered visible by the presence of layers or films of earthy matter. Near the top and bottom of the deposits the stratification layers are, however, usually better marked, *i.e.*, where the shale merges into the roof and floor. The planes of stratification are, however, shown by the weathered outcrops, and again when the shale is burnt, since it then splits up into more or less regular slabs along the lines of deposition.

The so-called "kerosene shale" does not differ very widely from cannel coal and torbanite. Like cannel coal, it usually appears to occur with ordinary coal in the form of lenticular deposits. Like cannel coal also, when of good quality it burns readily without melting, and emits a luminous smoky flame. When heated in a tube it neither decrepitates nor fuses, but a mixture of gaseous and liquid hydrocarbons distils over. It is extremely valuable for manufacture of illuminating oils and gas. When of good quality it yields from 150 to 180 gallons of oil per ton.

In colour it varies from a brown-black, at times with a greenish shade, to full black. The lustre varies from resinous to dull. The fracture is usually broad conchoidal, but the concavities are sometimes very deep in proportion to their breadth, and at times long flexible

concave-convex strips can be detached. When struck it emits a dull wooden sound. The powder is light-brown to grey ; the streak shining. It usually weathers to a light grey colour, and the surfaces of the joints also are often coated with a film of white clay; hence it has received the name of "White Coal."

It is easily cut into shavings. Thin sections under the microscope present a reticulated appearance. The network is black and opaque, enclosing brown and amber-coloured translucent particles.

The Hartley and Murrurundi shales are but slightly soluble, if at all, in alcohol, ether, carbon disulphide, petroleum, or caustic potash, even when boiled; but they gelatinize with boiling sulphuric acid, and evolve a sulphurous acid odour; with nitric acid they yield a yellow solution. Dr. Helms has kindly ascertained for me that the reputed New Caledonian "kerosene shale" behaves in much the same way with these reagents.

Prof. Silliman has proposed the name of *Wollongongite* for the mineral; but this has not come into general use, neither is it an appropriate name, since the specimen sent to him was not from Wollongong, but from Hartley. All the Wollongong oil shales which I have seen are of quite a different character; they are true shales with well marked lamination, black and fairly rich in carbon, and with a more or less greasy lustre, and often contain fossil ferns, especially the fronds of the glossopteris. No chemical examination has yet been made of any of them. Some of them yield a very large proportion of oil.

Unless it be decided to give the mineral a new name, I would suggest that it would be better to call it cannel coal or torbanite rather than kerosene shale, since the oil which it yields is probably not kerosene, and the substance itself is not strictly a shale, and moreover it is not very widely separated, either in physical properties or in chemical composition, from either torbanite or the cannel coals.

At Joadja Creek this mineral often contains impressions of the *glossopteris* and of the *vertebraria*. These fossil plant remains are usually best seen in the outcrops of the poorer portions of the shale deposits, and especially where somewhat weathered—the glossopteris fronds are generally found between the laminæ, the vertebraria run across them.

The occurrence of "kerosene shale" near Bathurst is mentioned in a book entitled *Two Years in New South Wales*, written by P. Cunningham, Surgeon R.N., published in London in 1827. He says, p. 4:—"A singular species of coal has been found at Bathurst, resembling in some degree the Scotch cannel coal * * * being nearly as light, and breaking with a similar fracture, while it burns almost with the steady brightness of a candle."

The following account of the discovery of the "Kerosene Shale" has been extracted from MSS of the late Rev. W. B. Clarke, and placed at my disposal by Mr. C. S. Wilkinson:—

"It has been known for many years that in the vicinity of the Great Western thoroughfare, and very near to the now-progressing line of railway from Sydney to Bathurst, at the base of Mount York, there exists a bed of coal, which is peculiar in its character and exceedingly inflammable. This property was discovered by the persons occupying the farm on Reedy Creek, who occasionally used it for fuel.

"In 1845 Count Strzelecki mentioned it in his 'Physical Description of New South Wales,' p. 129, as consisting of 'partial outcrops of coal observed in a small valley called the Reedy Valley (the Vale of Clwydd), north of Mount York and east of Mount Clarence, and which seemingly belong to the Newcastle basin—a probability, however, rather invalidated by the fact of the coals overlying masses of pure bitumen—a circumstance not discovered to exist elsewhere.'

"In 1847 the existence of coal in this position, as ascertained independently by myself in 1841, was introduced by me to the notice of the Legislative Council*; and in 1861, in a paper, drawn up at the express desire of my brother commissioner of the International Exhibition, which was printed in the Sydney Catalogue, I further mentioned that the Reedy Creek

* Report from the Select Committee on Coal, &c., ordered by the Council to be printed, 16th September, 1847.

coal, and a similar mineral at Colley Creek, on the north side of the Liverpool Range, would be likely to produce rock oil, and the specific gravity was alluded to as bringing it under close agreement with the Boghead coal of Scotland, viz., 1·204. It was stated that it was highly conchoidal in fracture, and lies in masses from 6 to 12 inches thick.† In reprinting the Catalogue in London the editor, without my authority, chose to strike out the paper in question, which was intended to information as to the extent of the coal-fields in New South Wales, and put the title at the head of a paper by another contributor, whose own appropriate description of his account was coal and collieries. Although this undeserved act had the effect of keeping out of view of the English reader the notice of the Reedy Creek cannel as oil-bearing, it did not prevent the turning of it to account by colonial manufactures, and in 1865 a sample of the oil distilled from it was brought to me. Other persons had formed favourable opinions of its qualities, and amongst the rest Mr. Watt, an accomplished chemist, for a time attached to the University of Sydney, brought it still further under notice.

"As the circumstances connected with what may probably become a source of colonial wealth are of some historical interest in relation to the geology of New South Wales, the above-mentioned facts have been related.

"Oil-bearing products have already been found in the *third* and *fifth* divisions; of these black cannel occurs in the latter at Stony Creek, near Maitland, on the Hunter River; brown cannel in the former at Reedy Creek; and shaly cannel on American Creek, at Illawarra, in various creeks running into the Wollondilly and Nattai Rivers, in the Grose River, in the Burralow Creek, a feeder of the latter, and in the Colo River. The Colley Creek cannel, which approximates to that of Reedy Creek, I believe will also be found to belong to the Upper Coal Measures."

Localities.—Hartley, Blackheath, Bathgate, near Wallerawang; Milalong, on the Cox River; Mount Megalon, and Mount York, county of Cook; Stony Creek, county of Wynyard; Joadja Creek, Berrima, Mount Kembla, Saddle Back, Cambewarra Ranges, Broughton Creek, and Toonalli River, Burragorang, county of Camden; Lake Macquarie and Greta, county Northumberland; and Colley Creek, near Murrurundi. It is said to occur as a 7-foot seam at a spot some 13 miles N.E. of Parkes, in the county of Ashburnham.

The analyses and descriptions of the specimens numbered 8, 9, 10, 11, 14, and 15 are by Mr. W. A. Dixon, F.C.S.

Greta Mine.

No. 1. The "kerosene shale" from this mine contains small specks of white clay. Specific gravity, 1·13

Proximate Analysis.

Loss at 100° C	1·475
Volatile hydrocarbons	53·798
Fixed carbon	27·946
Ash (grey)	15·870
Sulphur	·911
	100·000

Dried at 100° C.

Ultimate Analysis.

Carbon	65·610
Hydrogen	7·507
Oxygen and nitrogen	9·851
Sulphur	·924
Ash	16·108
	100·000

† "The Coal-fields of New South Wales," communicated by the Rev. W. B. Clarke; "Catalogue of Natural and Industrial Products of New South Wales, Sydney, 1861," p. 86.

Analysis of Ash.

Silica	29·643
Alumina	64·397
Iron sesquioxide	3·050
Manganese	absent
Lime	1·438
Magnesia	·250
Potash	·748
Soda	·355
Phosphoric acid	·744
	100·625

No. 2. Another sample from the Greta Mine gave the following results :—

Proximate Analysis.

Loss at 100° C.	·48
Volatile hydrocarbons	61·18
Fixed carbon	25·13
Ash	13·21
	100·00

HARTLEY.

No. 3. From the central part of a section taken from the Hartley seam, where it is most free from mineral matter. Exhibited at the Agricultural Society's Show, 1873.

Proximate Analysis. *

Moisture and volatile hydrocarbons	82·24
Fixed carbon	4·97
Ash	12·79
	100·00

Specific gravity, 1·052.

Ultimate Analysis.

Dried at 100° C.

Carbon	69·484
Hydrogen	11·370
Oxygen, nitrogen, and sulphur	6·356
Ash	12·790
	100·000

No. 4. A specimen from Hartley, examined by Prof. Silliman, and described under the name of Wollongongite (*American Journal of Science and Art*, II., xlviii, p. 85) under the erroneous impression that the mineral came from Wollongong.

Analysis.

Volatile hydrocarbons, including moisture	82·50
Fixed carbon	6·50
Ash	11·00
	100·00

* See "Minerals of New South Wales," p. 37, by A. Liversidge.

Joadja Creek Mine.

No. 5. Black, with a brownish shade; breaks with a large and well-marked conchoidal fracture.

Specific gravity, 1·103.

Proximate Analysis.

Loss at 100° C.	1·160
Volatile hydrocarbons	73·364
Fixed carbon	15·765
Ash	9·175
Sulphur	·536
	100·000

The ash is of a grey colour, with a slight reddish tinge.

No. 6. A second specimen had a specific gravity of 1·054.

Proximate Analysis.

Loss at 100° C.	·440
Volatile hydrocarbons	83·861
Fixed carbon	8·035
Ash	7·075
Sulphur	·589
	100·000

In this case the ash was practically white.

No. 7. A third specimen from the same locality gave the following results:—
Specific gravity, 1·229.

Proximate Analysis.

Loss at 100 C°.	·040
Volatile hydrocarbons	82·123
Fixed carbon	7·160
Ash	10·340
Sulphur	·337
	100·000

No. 8. *Proximate Analysis.*

Volatile matter	70·00 (including ·49 % of sulphur.
Fixed carbons	8·00
Ash	22·00
	100·00

15,399 cubic feet of purified gas per ton of shale.
Illuminating power, 46·35 standard sperm candles.
Hydrocarbons condensible by bromine, 24·05 per cent.
Sulphur in coal, 0·49 per cent.
Tar per ton of shale, 40 gallons.
Liquor ,, ,, 24 ,,
The illuminating power of the gas ranges from 38·46 to 48·32 sperm candles.
Specific gravity, 1·060.
The above particulars are taken from the catalogue of the Sydney Exhibition, 1879.

No. 9. In speaking of the kerosene mineral from Joadja Creek Mine, near Berrima, Mr. Dixon says,—"This mineral resembles the Boghead mineral from Scotland, but is considerably lighter, having a specific gravity of 1·098 against 1·20. The yield of volatile hydrocarbons is much greater than from even picked specimens of Boghead, whilst the ash is only half as great as in that mineral."

Specific gravity, 1·098.

Proximate Analysis.

Moisture	0·41
Volatile hydrocarbons	77·07
Fixed carbon	12·13
Ash	10·27
Sulphur	·12
	100·00

The coke was bright and lustrous.
The ash was white and voluminous.

No. 10. *Analysis of Ash.*

Alumina	14·74	Soluble in acid, 16·90
Ferric oxide	·76	
Lime	·30	
Magnesia	·45	
Phosphoric acid	·65	
Alumina	5·40	Insoluble in acid, 82·52
Ferric oxide	traces	
Silica	77·12	
Undetermined and loss	·58	
	100·00	

MUDGEE.

No. 11. Two specimens of shale from Mudgee District, one marked " 1-foot seam,' and the other " 3-foot seam." The first of them was dark-coloured, gave a dark streak, and had a slaty fracture in one direction, and a coarse grain and rough fracture at right angles to it. The slaty fracture showed impressions of leaves. The second specimen had a largely conchoidal coarse-grained fracture, and gave a somewhat lighter streak.

A preliminary examination showed that each gave the same amount of ash, so they were analysed together, as sent.

Specific Gravity, 1·728.

Proximate Analysis.

Water	.52
Volatile hydrocarbons	33.09
Fixed carbon	11·00
Ash	55·08
Sulphur	·31
	100·00

No true coke was formed, a black, incoherent powder being left. The ash was white in the 1-foot, and pinkish in the 3-foot seam. The small amount of hydrocarbons, and the large percentage of ash, renders them of little value for producing either oil or gas.

MURRURUNDI.

No. 12. A specimen from this locality, of a dark grey, almost black colour, but spotted with small specks of a white clay-like substance, gave the following results:—

Proximate Analyis.

Loss at 100° C	1·165
Volatile hydrocarbons	71·882
Fixed carbon	6·467
Ash	19·936
Sulphur	·549
	99·999

Dried at 100° C.

Ultimate Analysis.

Carbon	66·788
Hydrogen	9·712
Oxygen and nitrogen	2·774
Sulphur	·555
Ash	20·171
	100·000

No. 13. A very similar mineral is said to have been found in New Caledonia; the physical properties are the same, and the chemical composition is shown by the following analysis :—

Moisture	·55
Volatile hydrocarbons	64·62
Fixed carbon	8·71
Ash	26·12
	100·00

Ash.—White, with faint pink tinge.

Does not yield a coke, only a black powder.

Specific gravity, 1·238.

Mr. Hoff, of New Caledonia, informs me that the specimen had probably been taken from New South Wales, and found its way back to Sydney as a New Caledonian product.

Tarraba.

No. 14. A rather dull black-coloured shale, having a conchoidal fracture, a greasy feel, and giving a black streak and powder, from Tarraba.

Specific gravity, 1·247.

Proximate Analysis.

Water	2·74
Volatile hydrocarbons	43·61
Fixed carbon	32·72
Ash	20·12
Sulphur	·81
	100·00

This shale did not coke; a loose, black, incoherent powder being left on heating. The ash was reddish-white in colour, and voluminous; the separate grains of the material retaining their shape and individuality. This would not be of any value as an oil-making material; but would be of value for gas-making for local use.

The following analyses of Torbanite, Cannel Coal, and Albertite were expressly made to see how they compare in composition with the New South Wales kerosene shale :—

Torbanite.

Torbane Hill, Edinburgh.

No. 15. Black brown colour, light brown streak, flat conchoidal fracture. Scattered over with minute glistening particles.

Specific gravity, 1·316.

Proximate Analysis.

Loss at 100° C.	·720
Volatile hydrocarbons, &c.	69·695
Fixed carbon	9·045
Ash (white)	20·540
	100·000

Does not form a coke; a black powder only is left.

Cannel Coal.

Wigan, England.

No. 16. Black, well marked conchoidal fracture, shining streak and black powder.

Specific gravity, 1·259.

Proximate Analysis.

Loss at 100° C.	1·464	
Volatile hydrocarbons, &c.	45·900	
Fixed carbon	45·519	52·636 coke.
Ash	7·117	
	100·000	

A bright lustrous coke is found, somewhat cauliflower-like in form.

ALBERTITE.

New Brunswick.

No. 17. Intensely black, highly lustrous with well marked conchoidal fracture. Specific gravity, 1·105.

Proximate Analysis.

Volatile hydrocarbons, &c.	57·490
Fixed carbon	42·086
Ash	·424
	100·000

The ash is of a very pale brown colour.

The coke is highly lustrous, much swollen, hollow like a bladder, with smooth outward surface.

HYDROCARBON—Waratah Mine.

Amongst the specimens in the University collection is a piece of grey-coloured shale containing a curious more or less rectangular pipe-like perforation filled with a carbonaceous mineral.

There is no history to this specimen, but it is labelled "over the Waratah seam," hence it doubtless came from the colliery of that name.

The mineral is jet black, highly lustrous, very brittle, breaking into long more or less regular four-sided prismatic pieces. These prisms run at right angles to two of the walls of the pipe. The cross fracture is conchoidal—the powder or streak is black.

The powdered mineral is insoluble in alcohol, bisulphide of carbon, benzol, ether, ammonia, caustic soda, and sodium hyposulphite, but it is partly soluble in boiling nitric acid, yielding a brown solution.

Readily inflammable, does not fuse, burns with a smoky luminous flame and disagreeable smell.

On platinum foil swells up but slightly.

Specific gravity, 1·30. Hardness about 2.

Proximate Analysis.

Loss at 100° C.	3·600	
Volatile hydrocarbons, &c.	29·174	
Fixed carbon	63·772	Coke, 64·836 %
Ash	1·064	
Sulphur	2·380	
	99·990	

The ash is of a rich brown colour, light and spongy. No true coke is formed; the residue fritts together and swells up slightly.

Ultimate Analysis.

Moisture at 100° C.	3·600
Carbon	70·246
Hydrogen	5·080
Oxygen	17·630
Sulphur	2·380
Ash	1·064
	100·000

It does not quite agree with any described mineral, but on the whole it seems to resemble albertite more closely than any other. The composition does not yield a satisfactory formula. It is perhaps unnecessary to make a new mineral species of this substance.

TABLE IV.

"Kerosene Shales," compared with other Hydrocarbons.

Locality.	Moisture.	Volatile Hydro-carbons.	Fixed Carbon.	Ash.	Sulphur.	Specific Gravity.	Analyst.
Joadja Creek	0·44	83·861	8·035	7·075	0·589	1·054	Liversidge.
Hartley Vale	......	82·50	6·50	11·0	......	......	B. Silliman.
Joadja Creek	0·04	82·123	7·160	10·340	0·337	1·229	Liversidge.
Hartley Vale	......	82·24	4·97	12·79	......	1·052	,,
Joadja Creek	0·41	77·07	12·13	10·27	0·12	1·098	W. A. Dixon.
Joadja Creek	1·16	73·364	15·765	9·175	0·536	1·103	Liversidge.
Cannel Coal, Mold Flints	......	72·08	21·91	6·01	......	......	Percy.
Murrurundi	1·165	71·882	6·467	19·936	0·549	......	Liversidge.
Torbanite, Torbane Hill	......	71·17	7·65	21·18	......	1·170	How.
Cannel Coal, Scotland	......	69·77	10·45	19·78	......	......	Percy.
Torbanite, Torbane Hill	0·720	69·695	9·045	20·540	......	1·316	Liversidge.
New Caledonia (Hartley's)	0·55	64·62	8·71	26·12	......	1·238	,,
Greta Mine	0·48	61·18	25·13	13·21	......	......	,,
Albertite, from New Brunswick	......	57·490	42·086	0·424	......	1·100	,,
Greta Mine	1·475	53·798	27·946	15.870	0·911	1·130	,,
Cannel Coal, Wigan	1·464	45·900	45·519	7·117	......	1·259	,,

The following table was prepared by Professor Chandler, of Columbia College, New York, to compare the Hartley mineral with Grahamite and Albertite, both of which are used for enriching gas :—

	Volatile matter.	Fixed Carbon.	Ash.	Gas per ton of 2,240 lbs., in cubic feet.	Candle power of gas.	Coke per ton of 2,240 lbs.		Gas purified by 1 bushel of lime, in cubic feet.
						lbs.	Bushels.	
Grahamite, West Va.	53·50	41·50	2·00	15·000	28·70	1,056	44	......
Albertite, Nova Scotia	57·70	41·90	0·40	14·784	49·55	806	16	......
Hartley mineral, N. S. Wales	82·50	6·50	11·00	13·716	131·00	424	...	5,686

Return showing the quantity and value of Shale produced in the Colony of New South Wales :—

Year.	Quantity.	Value.
	Tons.	£
1865	570	2,350
1866	2,770	8,154
1867	4,079	15,249
1868	16,952	48,816
1869	7,500	18,750
1870	8,580	27,570
1871	14,700	34,050
1872	11,040	28,700
1873	17,850	50,475
1874	12,100	27,300
1875	6,197	15,500
1876	15,998	47,994
1877	18,963	46,524
1878	24,371	57,211
1879	32,519	66,930
1880	19,201	44,725
1881	27,894	40,748
Total	241,284	581,046

Jet.

A true jet which takes a high polish and breaks with a conchoidal fracture, occurs as occasional layers in the "shale" at Hartley, Joadja Creek, and other places; but up to the present time no seams exceeding one-third of an inch in thickness have been found.

Lignite.—Brown coal.

Chem. comp.: Carbon, hydrogen, oxygen, and ash. This substance may be looked upon as an imperfect coal, being intermediate in composition between wood and coal. In some cases it still retains the original fibrous woody structure; in other cases it is shaly or massive.

Found at Kiandra, where there is said to be a bed of lignite 30 feet in thickness. Brown, but black in parts, with a pitchy lustre; fracture subconchoidal; exhibits woody structure. On the Lachlan River, where it possesses a platy structure; Dubbo; found also on Mr. Berry's land, at the mouth of the Shoalhaven, at a depth of 12 feet; also at Turalla Creek, county of Argyle, retains original structure of the wood, and has much the same appearance as "bog oak."

At Chonta, between Tura and Boonda, about 42 miles north of Cape Howe, there are beds of lignite, charged with iron pyrites, in association with kaolin; the clay containing the lignite is said to yield a fair proportion of lubricating oil. A so-called lignite occurs at Bowinda Cliff.

In preparing the foundation for the bridge over the Parramatta River some wood was found at a depth of 44 feet, passing into the state of lignite. The colour was very dark, being almost equal to that of bog oak.

The air-dried specimen sunk when immersed in water, being somewhat denser.

Proximate Analysis.

Moisture at 100° C.	20·82
Combustible matter	68·97
Ash	10·21
	100·00

The ash contains iron, alumina, lime, baryta, magnesia, potash, and soda, in combination with silica, sulphuric, hydrochloric, and phosphoric acids.

Resinite.

Reported to occur on the Clarence River.

Bog Butter.

A soft, white, somewhat unctuous substance, like fat, only less greasy; inclined to crumble to pieces when pressed. Probably a form of *adipocere.*

Found between Twofold Bay and Brogo.

Dried at 100° C.

Ultimate Analysis.

Carbon	80·648
Hydrogen	5·618
Nitrogen	5·461
Oxygen	1·553
Ash	6·720
	100·000

The above results do not afford a satisfactery formula.

Mineral Wax.—Ozokerite.

Chem. comp.: Carbon, hydrogen, and oxygen. Of a brown-grey colour. Breaks with a subconchoidal fracture. Coola.

Bitumen.

Mr. Bolding, Commissioner for Crown Lands, informs me that bitumen oozes out of a sandstone rock, at a place some 15 or 20 miles from Coonanbarabran, on a creek which flows into the Castlereagh River.

Elaterite.—Elastic bitumen.

Chem. comp.: Carbon, hydrogen, and oxygen. At Reedy Creek or Petrolia there is said to be a band of thin and very elastic substance like elaterite.

Class II.

Sulphur.

Native Sulphur.

Occurs in small quantities as a sublimate from the vents of Mount Wingen, the so-called "Burning Mountain," in association with iron sulphate and various other salts.

Also found in minute crystals in the cavities of auriferous quartz veins on the Louisa Creek, county of Wellington, in association with hæmatite and zinc blende.

It is said to occur at Tarcutta, county of Wynyard.

Class III.

Salts.

Common Salt.

Chem. comp.: Sodium chloride, NaCl. Common in most spring waters; occasionally found as an incrustation from the evaporation of lakes and waterholes. Found in rock crevices near Picton.

Natron.

Chem. comp.: Hydrated sodium carbonate, $Na_2CO_3,10H_2O$. Said to occur as a deposit from the Mud Wells in the Namoi Scrub.

Epsomite.

Chem. comp.: Hydrated magnesium sulphate, $MgSO_4$, $7H_2O$. Occurs as an efflorescence in the caves and under overhanging rocks of the Hawkesbury sandstone; usually masses of fibrous crystals are met with, sometimes 5 or 6 inches in length, of a beautiful white silky lustre. The crystals are usually curved at the free end; also in radiate groups of small crystals. Very fine specimens have been obtained from Dabee and Mudgee, county of Phillip; Wallerawang, county of Cook; the Great Western Mines, Icely, and Burragorang.

With feather alum in caves in the coal measures, at Cullen Bullen; and the Turon District, county Roxburgh; and Manero.

Alunogen.—Halotrichite, Feather Alum. Sulphate of Alumina.

Chem. comp.: Hydrated aluminium sulphate, $Al_2O_3,3SO_3$, $18H_2O$. Commonly called "alum," from its astringent taste, but potassium sulphate is usually present in but small quantity.

Commonly met with as an efflorescence in caves and under sheltered ledges of the Coal Measure sandstone, usually with Epsomite, as at Dabee, county of Phillip; Wallerawang and Mudgee Road, county of Cook; the mouth of the Shoalhaven River, and other places. Also found in the crevices of a blue-slate at Alum Creek, and at the Gibraltar Rock, county Argyle. Occurs as a deposit with various other salts from the vents at Mount Wingen, county of Brisbane, together with native sulphur in small quantities; and at Appin, Bulli, and Pitt Water, county of Cumberland. At Cullen Bullen, in the Turon District, county of Roxburgh; at Tarcutta, county of Wynyard; and Manero.

A specimen in the form of fibrous masses, made up of long, acicular crystals, white, silky lustre, like satin spar, found as an efflorescence in a sandstone cave near Wallerawang, was found to have the following composition :—

Analysis.

Water	47·585
Matter insoluble in water	1·079
Alumina	15·198
Sulphuric acid	34·635
Soda	·931
Potash	·337
Loss	·235
	100·000

The formula for the above is practically $Al_2O_33SO_3 + 18H_2O$.

Another specimen from the same place was found to contain a notable quantity of magnesium sulphate.

Analysis.

Water, by difference	47·388
Silica	1·908
Alumina	13·113
Sulphuric acid	33·067
Lime	·798
Magnesia	3·726
	100·000

The formula for the above is also practically $Al_2O_33SO_2 + 18H_2O$.

Mr. W. A. Dixon has also examined a specimen of this halotrichite, as follows :—

" A yellowish-white porous mass, containing numerous tufts and masses of acicular crystals (hair salts) from Bungonia, gave on analysis :—

Analysis.

Sulphuric oxide	23·74	Soluble in water.
Sulphurous ,,	traces	
Alumina	11·65	
Ferrous oxide	1·10	
Magnesia	·99	
Potash	1·36	
Soda	traces	
Ferric oxide	1·91	Soluble in acid.
Magnesia	traces	
Silica	32·25	
Water	27·12	
	100·12	

" It is somewhat difficult to state the proximate constituents of this substance, as there is not enough sulphuric acid present to form normal salts, nor enough water to yield with the sulphate of alumina the usual crystalline salt. The probable contents are :—

Sulphate of alumina and potash (alum)	10·61
,, ,, magnesia (Epsom salts)	5·09
,, ,, iron (copperas)	3·58
,, ,, alumina (Al_2O_3 ,$3SO_3$)	23·06
Basic sulphate of alumina ($3Al_2O_3$, SO_3)	3·50 "

Websterite.

Chem. comp. : Aluminium sulphate. Reported to occur on Brush Creek, Dumaresq River, county of Arrawatta.

Class IV.

Earthy Minerals.

Calcite.—Iceland spar, Limestone, and Marble.

Chem. comp. : Calcium carbonate, $CaCO_3$. Hexagonal system. Sometimes well-developed crystals are met with. The usual forms are rhombohedra and their combinations, also combined with the terminal pinakoid or o p plane, and occasionally scalenohedra. I have not as yet observed the prism among the New South Wales forms.

The localities for calcite are extremely numerous, as it is not only met with wherever limestone occurs, but it is also a common substance in mineral veins.

Iceland spar occurs in small crystals near Dubbo.

Large well-developed flat rhombohedral crystals of calcite occur, associated with quartz, in the joints and cavities which exist in the basalt of the Pennant Hills, near Parramatta ; at Gunnedah and Manilla. It is also met with in the quartz veins in association with, and as the matrix of, gold, as at Gulgong and other places. It is sometimes present in the joints in sandstone, as at the Cataract River.

Opaque white calcite occurs at Capertee, county of Hunter ; in serpentine at Jones' Creek, near Gundagai. Impure calcite in radiate groups of opaque white crystals occurs at Dunlop, Darling River. Good specimens have been obtained from Carwell. Crystals of black calcite have been found at Dayspring, Parkes, and Wollongong.

Marble.—Several beds of very fine marble, or crystalline limestone, occur in different parts of the Colony, as at Wollondilly, whence one of the marbles, used in paving the great hall of the University, the Post Office, and other public buildings in Sydney, has been obtained. Much of the Wollondilly so-called " white marble " is of a creamy tint, variegated with pale red and light blue streaks. A slate-coloured marble, used in the same buildings, is brought from Marulan, near Goulburn. There is a beautiful white saccharoid marble at Cow Flat, near Bathurst, a brecciated slate-coloured marble streaked with white calcite occurs at Wallerawang, county Cook, under the following circumstances.

" Between the iron ore deposits and the coal seam outcrops there is seen an outcrop of limestone abutting against Devonian or Upper Silurian slates. Both the slates and the limestone are here standing at a high angle. The limestone does not show the dip so distinctly as the slates, for the lines of bedding have been almost completely obliterated, but the dip appears to be about 75° to the eastward, and the strike nearly N. and S. At the junction of the two the limestone has evidently undergone disturbance and is much brecciated, and includes within it fragments of the slate. Some of the included slate contains small crystals of iron pyrites disseminated through it. In colour the limestone is of a bluish-grey or slate-colour, much veined with white calcite. The slate-coloured portions break with a slight crystalline appearance, but the calcite veins show the rhombohedral cleavage of that mineral on a large scale. Its extension can be traced for a long distance to the north."—" Iron and Coal Deposits at Wallerawang," *Jour. Royal Society of N.S.W.*, 1874.

Beautiful marbles occur at Mudgee and Orange ; also at Wellington, celebrated for its caves. At Bangalore, on the Goulburn Plains, there is found a white crystalline marble ; at Yass and Queanbeyan, county Murray ; good grey and white crystalline marbles are found along the banks of the Murrumbidgee ; the Belubula River and the Conomodine Creek, in the Orange District. Blue-grey limestone at Warialda, county Burnett. The outcrops of small seams of grey crystalline limestone or marble are seen exposed in the Minumurra Creek, near Jamberoo, county Camden, interbedded with the coal, shale, and sandstones of that district.

A specimen from a 2-inch band in the Minumurra Creek was slightly crystalline, of a grey colour, with a few thin streaks of a lighter colour. Small patches of a pale green mineral were detected in parts, something like glauconite in appearance.

It contained a considerable amount of impurity, and left a noticeable residue when decomposed with hydrochloric acid.

Specific gravity, 2·679.

Analysis.

Water lost at 105° C.	·73
,, combined	2·00
Silica and substances insoluble in acid	13·08
Soluble silica	·52
Iron sesquioxide	5·02
,, protoxide	3·52
Alumina	·46
Lime	38·27
Strontia	traces
Carbonic acid	35·70
Loss	·70
	100·00

A jet black marble, traversed by veins of white calcite, occurs at Armprior, Shoalhaven.

Variegated and white statuary marbles occur about 4 miles north of Parkes, in the county of Ashburnham.

In the county of Roxburgh, at Mitchell's Creek; near Bathurst; in the county of Argyle, at Marulan and Murrumbateman; at Bookham and Marsden, county of Harden; in the county of Georgiana, at the Abercrombie Caves, and Rockley; at the Manning River; in the county of Ashburnham, at Carrawabbity, and near Forbes; at Port Stephens, county of Gloucester; at Tarrabandra, near Tumut, county of Wynyard, there is a richly variegated marble; Tarrago Creek; Yass Plains, county of King; Havilah, near Mudgee, and Wellington, county of Wellington; at Wallabadah, county of Buckland.

A dark bluish grey limestone, full of fossils, *Atrypa*, from Windellama Creek, county of Argyle, gave the following results:—

Analysis.

Water, at 100° C.	·071	
Silica	2·208	
Alumina and traces of iron	1·003	
Lime	54·602	96·971 carbonate of lime.
Magnesia	absent	
Potash	trace	
Soda	trace	
Chlorine	trace	
Carbonic acid	42·369	
	100·253	

A white crystalline limestone from Wallerawang gave—

Analysis.

Carbonic acid	42·33
Lime	53·42
Magnesia	·56
Ferric oxide	·75
Alumina	traces
Phosphoric oxide	·11
Silica	2·90
	100·07

The following five analyses and descriptions are by Mr. W. A. Dixon *(Report of the Mining Department*, Sydney, 1880*)* :—

A grey crystalline limestone, from Wollongong, contained—

Analysis.

Carbonate of lime	74·28	Soluble in acid, 80·10
,, magnesia	·82	
Alumina	1·46	
Oxide of iron	3·12	
Phosphoric oxide	·42	
Alumina	5·80	Insoluble in acid, 16·49
Silica	10·69	
Oganic matter and water	3·71	
	100·30	

Limestones from Bulli were found to have the following compositions :—

Analyses.

	No. 1.		No. 2.	
Moisture and organic matter	3·95		2·82	
Carbonate of calcium	62·44	Soluble in acid.	92·04	Soluble in acid.
,, magnesium	·36		1·32	
Alumina	2·96		1·02	
Oxide of iron	4·09		·63	
Alkalies and loss	·17		·23	
Lime	·84		—	
Alumina and traces oxide of iron	2·10		—	
Silica	23·09		1·94	
	100·00		100·00	

Wallerawang Reserve.

A subcrystalline, containing fossils such as corals, encrinites and other similar forms, which had weathered and become exposed on the surface. In colour almost white, mottled with pale-grey, and further variegated by occasional brown streaks. Should polish well.

Analysis.

Silica and insoluble matter	00·720
Sesquioxide of iron and alumina	1·100
Lime	54·096
Magnesia	·567
Carbonic acid	42·704
Undetermined	·813
	100·000

Tarrabandra.

A subcrystalline limestone; but rather more crystalline than that from Wallerawang Reserve. In colour almost white, possessing but a pale buff shade marked with bluish grey bands. It is probable that this marble would take a rather better polish than the former.

Analysis.

Silica and insoluble matter	00·160
Sesquioxide of iron and alumina	1·750
Lime	54·600
Carbonic acid	42·898
Magnesia	·605
	100·013

Oolitic Limestones.—A limestone of this structure is said to occur on the Page River county of Brisbane.

Concretions.—Calcareous concretions are common in the black and chocolate coloured soils of igneous origin, which occur in various parts of the Colony, such as on the Liverpool Plains, New England, Gwydir District, Hunter River District, and at Scone, and in numerous other localities where there is a soil derived from the decomposition of a basaltic or other igneous rock.

Dana describes in the *Geology of the United States Exploring Expedition round the World*, 1838-42, some "calcareous concretions of remarkable prismatic forms, occurring in clay at Glendon, probably pertaining to the sandstone rocks. Some of the crystals are 20 inches long, the average size being 3 or 4 inches. They have a rhombic form, and taper towards each extremity, the two ends curving slightly in opposite directions. Stars of four and six rays, and also globular masses, bristled on all sides with the ends of prisms are common among them. They have a very rough brownish exterior, like a fragment of sandstone; and within, instead of the regular cleavage structure of a proper crystal, the texture is crystalline granular. A surface of fracture glistens like a fine-grained statuary marble, though less bright. An attempt was made to burn them for lime, but they crumbled and so clogged the fire that it was abandoned.

"At one of the localities the specimens are coated with minute crystals of gypsum; they were probably formed through the decomposition of iron pyrites, this mineral giving rise to the sulphuric acid which united with the lime of the concretions. The rough surface of these rhombic concretions may have arisen from erosion by this process, or by the action of water percolating through the clay."

Arragonite.

Chem. comp.: Calcium carbonate, $CaCO_3$.

Rhombic system. Good crystals of this form of carbonate of lime are perhaps more common than of the mineral calcite, especially upon stalactites in certain of the limestone caves, and as enclosures within the amygdaloidal cavities of basalt.

Beautiful groups of crystals and bunches of *flos ferri* have been obtained from the limestone caves at Lob's Hole, the Coodradigbee, county Cowley; the junction of Cotter's River and the Murrumbidgee, county Murray; and from near Bungonia, county Argyle. It also occurs at the Cataract River, and fair specimens of stalactitic arragonite are to be seen at Port Hacking. The more or less spherical concretions termed "cave pearls" by Professor Boyd Dawkins, F.R.S., are also found in some of the above caves, notably those at the Coodradigbee.

Arragonite occurs in vesicular basalt at Cherry-tree Hill near Mudgee, groups of radiating crystals several inches in length are met with in a similar rock at Inverell in serpentine on the Peel River, and on the Liverpool Plains; Jordan's Hill, Cudgegong, county Wellington; at the Brick Kiln, Rock Flat, in radiate columnar crystals of variegated green and white colours.

Calcareous Tufa, Travertine, or Fresh-water Limestone.—At Burragorang, at Waibong, Picton, county Camden; Quialago Creek, Goulburn Plains, and at Newstead Station, New England, county Gough.

The fresh water limestone at Newstead is of a greyish white colour, and is as shown by the following analysis very impure.

Specific gravity = 2·69.

Analysis.

Moisture, at 100°C.	·736	
Alumina	5·988	Soluble in hydrochloric acid.
Iron sesquioxide	1·760	
Manganese protoxide	·989	
Lime	10·571	
Magnesia	·575	
Potash	·353	
Soda	·598	
Carbonic acid	8·450	
Silica	55·430	Insoluble in hydrochloric acid
Alumina	14·116	
Loss	·434	
	100·000	

Fluorspar.

Chem. comp. : Calcium fluoride, CaF_2. Crystallizes in the cubical system.

Up to the present it has apparently only been found in the massive state, or in but very imperfect octohedral crystals. This mineral has been met with in several places in the New England District, near to Inverell, at Elsmore; at the Boundary, Sydney and Caledonian Tin-mines, on Cope's and Middle Creeks, county Hardinge, where it is found in association with tin-stone, a green steatitic clay, copper pyrites, galena, quartz, molybdenite, and other minerals, all of which may often be seen in one hand specimen.

It also occurs at South Wiseman's Creek, county Westmoreland, in association with copper ores; on Mitchell's Creek, county of Roxburgh; in certain cases the fluor is much fissured, and the cracks are filled in with red oxide and blue carbonate of copper, which impart to the mineral a very pretty and ornamental appearance, and it would in consequence probably serve for inlaid work. At Woolgarloo Lead-mines and Silverdale it is found in the massive state as the matrix of galena; where it is usually opaque or but semi-translucent, white, with pale-bluish or purple veinings.

Mr. Wilkinson reports its presence in the Devonian beds at Mount Lambie, county Cook; also at Gow's Creek, near Wallerawang, where it occurs in small veins, traversing a felspathic rock.

Selenite—Gypsum.

Chem. comp.: Hydrated calcium sulphate, $CaSO_4,2H_2O$. Rhombic system. Found crystallized in clay on the Darling River. Also on the Bogan River. Occurs near Singleton, and on Ash Island, on the Hunter River, county of Northumberland; on the Cudgegong River, county of Phillip; Lake Cobham; the Grey Ranges, county of Evelyn; Bungonia, county of Argyle; at Cooma, county of Beresford; at Irrawang; and near Yass, county of King. Of commercial value for the manufacture of Plaster-of-Paris and other cements.

Apatite.

Chem. comp.: Chloro-phosphate of calcium, $3Ca_3P_2O_8$, Ca(FCl). Crystallizes in the hexagonal system, in the form of six-sided prisms. It is reported to occur in well-formed crystals with bitter spar on the Lachlan, between Boco Rock and Wog-wog, and with graphite and quartz at the head of the Abercrombie River, county Georgiana; also on the Clarence River.

This mineral is of considerable commercial value.

I have not yet met with any strontium minerals in New South Wales, nor do there appear to be any records of their discovery.

Barytes.—Heavy Spar.

Chem. comp.: Barium sulphate, $BaSO_4$. Rhombic system. With fibrous and massive green carbonate of copper, copper pyrites, and galena, at Cambalong, Merinoo, county Wellesley. Also with antimony ochre, near Kempsey, county of Dudley, with copper carbonates at Bibinluke, near Bombala, county of Wellesley; on Euroka Creek with iron oxides; at Winterton Mine, Mitchell's Creek, Bathurst District, in more or less well formed small tabular crystals associated with gold and other minerals; a vein of barytes twelve inches in width is said to exist at Croker's, on the Rocky Bridge Creek.

Dr. Hector, F.R.S., Director of the Geological Survey of New Zealand, reports having found a vein of barytes, in 1877, on the Canobola Ranges, between the Lachlan and Belubula rivers, near the junction of the Devonian limestone, with diorite schists intersected by porphyries and bands of serpentine. The barytes contains a little copper and is associated with micaceous iron in lamellar crystals which are so thin as to be translucent.

Brucite.—Magnesium Hydrate.

Chem. comp.: MgO,H_2O or $MgH_2O_2 = MgO\ 69{\cdot}0$; water, $31{\cdot}0 = 100$.

Crystallizes in the hexagonal system in rhombohedral forms. Said to occur on Louisa Creek, county of Wellington.

Hydrotalcite.

A hydrate of alumina and magnesia.

This is a soft, white, and pearly mineral, with a greasy feel. Said to occur in New South Wales.

Magnesite.

Chem. comp.: Magnesium carbonate, $MgCO_3$. It is most commonly found massive, or in concretions, having a mammillated or botryoidal form.

H. = 4 to 5. Specific gravity, 2·94.

It is found in New England in various places, and upon the diamond-fields at Bingera, county of Murchison; and near Mudgee; when impure it is of a grey or grey-brown colour, but when pure it is of a dazzling white; compact, tough, and breaks with a flat conchoidal fracture. It adheres to the tongue, and has a very cold feel like porcelain.

It effervesces with hydrochloric acid, but with difficulty.

At the diamond-diggings at Two-mile Flat, near Mudgee, pure white magnesite was observed to form by the spontaneous decomposition of the heaps of refuse from the miners' shafts; pebbles were quickly cemented together by it.

The late Dr. Thomson, of the Sydney University, found that the magnesite thus formed, and incrusting rubbish heaps, timber, old tools, &c., had the following composition:—

Magnesia	46·99
Carbonic acid	49·78
Water	4·08
	100·85

Specific gravity = 2·94.

This magnesite sometimes contained calcite. It was also observed under the same circumstances on Cunningham's Diggings on the east side of Cudgebegong Creek, and there with a peculiar vermicular or worm-like form.

Other localities are the Lachlan River, Mooby Gully, Scone, county of Brisbane; Louisa Creek, county of Wellington; Barraba, county of Darling; Lewis Ponds Creek, county of Wellington.

Dolomite.—A double carbonate of lime and magnesia. Found at Carwell, Shoalhaven District.

Wavellite.

Chem. comp.: A hydrated aluminium phosphate. A yellow mineral, reported to be Wavellite, with a radiate structure is found in the fissures of the felstone pebbles common in Rat's Castle Creek, Two-mile Flat, Mudgee.

Silica.

Quartz.—Rock crystal.

Chem. comp.: Silica. Hexagonal system. Found in nearly all parts of the Colony, and in crystals more or less perfectly developed; the most common form is the prism combined with the pyramid. Occasionally the prisms are closed at both ends by planes of the pyramid; also as double pyramids; such crystals are, however, usually small and generally occur in quartz porphyries, or are derived from the decomposition of such, found at Glenlyon, Home Rule, and Cooyal, county of Phillip; Solferino, county of Drake; and Peel River, county of Parry.

Occasionally some very large crystals are found, notably at Newstead Tin-mine, New England, where, in one of the shafts, crystals of nearly 1 cwt. were met with; within these, crystals of tinstone were often found disseminated.

Large crystals of smoky quartz are common almost throughout New England, as at Bingera, county of Murchison; smoky brown Cairngorm with limpid quartz crystals are plentiful in Ranger's Valley, River Severn, and Inverell, county of Gough; Macintyre River, Middle Creek, and Byron's Plains, in the same county; and at Oban; Cope's Creek, county of Hardinge; Uralla, county of Sandon; Mudgee, county of Phillip. Some of the rock crystals found in the alluvial tin deposits present a very pretty appearance, from the presence of numerous minute fissures and internal films, streaks and patches of yellow, orange, and red colours. Most of the crystals from New England have one face of the pyramid much more largely developed, so much so in some cases as to almost obliterate the other faces.

Elongated pyramids containing disseminated crystal of cassiterite are common at the Albion Tin-mine; these crystals of quartz are dull and slightly rough on three of the faces, and bright on the opposite three.

White, colourless, and tinted quartz, pseudomorphous, after calcite, and other minerals is abundant in some portions of the Yass District.

Quartz crystals with rounded edges and dull surfaces, as if acted upon by hydrofluoric acid' occur in the coarse-grained granite on Mann's River.

Quartz crystals are common near the junction of the Turon and Macquarie Rivers; at Bukkulla, county Arrawatta, clear and brilliant crystals; the Diamond Mountain, Cudgegong, Macquarie River; in an amygdaloidal basalt, Deep Lead, Gulgong Rush, county Phillip; at Carcoar, containing lamellar magnetite, also with a pale blue quartz. Well-developed and brilliant crystals from Bullamalite Creek, a tributary of the Mulwaree, near Goulburn, at Gurragangamore and other places on the Goulburn Plains; the Lachlan River; at Cooma and Kiandra, county Wallace; the Murrumbidgee; in the Naas Valley, county Cowley, with tourmaline and schorl; between Pambula and Eden, with molybdenite.

Beautifully formed clear and transparent rock crystal occur on the Louisa Creek, county of Wellington. Also citrine, red, amethyst, and opaque white, remarkable in certain cases for the peculiar yellow and iridescent tarnish of many specimens. Peculiarly flattened forms are also found here, with four faces of the pyramid enormously developed; the remaining two being so much reduced, to a mere line almost, as to give the crystal the appearance of a rather acute rhombic pyramid.

Up to the present the number of substances which I have observed enclosed within quartz crystals found in this Colony is not great.

Endomorphs in Quartz Crystals.

1. Actinolite—Mowembah, Merrendee, on the Meroo, a tributary of the Cudgegong, county Wellington.
2. Asbestos—Uralla, county Sandon.
3. Cassiterite or Tinstone—Albion and Newstead Mines, New England.
4. Epidote—Towamba and Manero, Morullan, on the Gwydir River.
5. Argentiferous Galena—New Summer's Hill, Bathurst.
6. Gold—Boro Creek and other places, county Murray; rough vein quartz is the commonest matrix of gold.
7. Graphite—Head of Abercrombie River, county Georgiana.
8. Orthoclase felspar—Two-mile Flat, Mudgee, county Phillip.
9. Molybdenite—Bullio Flat, near Goulburn, county Argyle.
10. Rutile.
11. Schorl and tourmaline—Murrumbidgee.

Pseudomorphs.—That is, quartz possessing the external form of other minerals. Quartz after calcite—Gulgong, Yass, and Bathurst; also, often iron pyrites and mispickel.

Rose Quartz.—Occurs with manganese on Hall's Creek, Moonbi Range.

Amethyst.—A purple-coloured variety of quartz. It occurs as geodes in the basalt at Kiama; the crystals are usually small, not being more than $\frac{3}{8}$ of an inch through. Found also at Dubbo. A quartz vein containing amethystine quartz occurs near the top of Bullabalakit; also near Bathurst.

Agate.—Agates consist of mixtures of crystalline quartz and chalcedony, usually arranged in concentric layers and bands; their structure is caused by the peculiar mode of formation, viz., by the infiltration of silica into the amygdaloidal cavities of igneous rocks.

They are common in the basalt at Kiama, county Camden; near Scone, county Brisbane; Inverell, county Gough; and other places; and are very plentiful in the beds of many of the rivers and old drifts of New South Wales, as in the Macintyre, parts of the Gwydir, the Hunter, the Cookaboo, where they are derived from the basalt of the Western Range or Dewingbong Mountain, Gunningbland, Lake Cobham, Grove Creek, Trunkey, and Narrabri.

Agates are reported to occur at Mount Agate, near Mount Wingen, county of Brisbane, encrusted with native copper.

Agates and chalcedony are plentiful near Dubbo and Bald Hill, Wellington, Mount Wingen, Maitland, Cowriga, and other places.

Jasper.—Is very abundant and widely distributed throughout various parts of New South Wales. It is found of nearly all shades of colour—pure white, grey, slate, dull blue, olive and bright greens, brown, red, and black, both alone as simple colours, and in varied combinations of stripes, streaks, and mottlings.

It is found mainly in the form of boulders and pebbles in river beds, and it enters largely into the composition of nearly all conglomerates, gravelly alluvial deposits, and river drifts. Much of it is evidently derived from the conglomerate of the Coal Measures.

The peculiar variety known as Egyptian jasper does not appear to have yet been met with.

Amongst the principal localities are the Gwydir, the Macintyre, the Richmond, the Macquarie, Cudgegong, the Hunter, the Murrumbidgee, and many of their tributaries. There are large quantities of fine red jasper near Gobolion, county Ashburnham; and at Scone, county of Brisbane. The drifts at Mudgee, in the county of Phillip; Bathurst; Bingera, county of Murchison; Lake George, county Murray; Molong, county Ashburnham; Woolomon, and other places, are rich in fine jasper specimens.

Ribbon Jasper.—At the junction of Pink's Creek with the Bell River a clay slate has been converted into ribbon jasper.

Eisenkiesel.—A variety of ferruginous quartz. Large masses of this mineral *in situ* occur near Bingera, county Murchison: it also abounds between Guano Hill and the Bell River, at Carcoar, county Bathurst; Mount Lindesay, Lowee, and at the junction of Cotter's River with the Murrumbidgee, county Murray.

Lydian Stone.—A velvet black form of jasper, used by jewellers as a touchstone for gold alloys. Mullion Range, Bathurst country.

Chert.—Common in seams and bands throughout the coal measures. Its structure is often more or less lamellar, and the fracture conchoidal.

Abundant about Mount Victoria, Wallerawang, and Hartley, county Cook; Jamberoo, county Camden; Illawarra, and Lachlan River.

Chalcedony.

An amorphous or crypto-crystalline form of quartz. There are several varieties of chalcedony.

Chalcedony proper : Massive, translucent, pale-grey, blue, or brown ; with waxy lustre surface mammillated, and often of a stalactitic form.

Nodules of chalcedony are found near Carcoar, county Bathurst ; at Lowee ; with resinite and chert ; also at Gulgong, Home Rule, county Phillip ; Cowriga Creek, Wellington, Dubbo, Maitland, the Hunter River, and filling lines of small cavities in a green felstone on Rat's Castle Creek, 6 miles S.E. of Two-mile Flat, county Phillip ; Gunnedah, Newstead, Walcha ; Monaltrie, on the Richmond River ; at Nundle, bluish grey ; also at Narrabri.

Found pseudomorphous after quartz at the Elsmore Mine, near Inverell.

Carnelian.—Is a bright red chalcedony, but the ornamental white varieties of chalcedony are also usually included under the same name by jewellers.

Red and white carnelians are rather common in the Hunter River, at Maitland, and other places ; also near Wellington ; in Pond Creek, near Inverell, county Gough.

Carnelian in quartz porphyry, on Nymboi River, Clarence River. Beautifully coloured carnelians also occur on the basaltic country about the Tweed River.

Onyx occurs in the neighbourhood of Narrabri.

Cat's-eye.—A variety of chalcedony, which, from the presence of capillary crystals of asbestos, shows a peculiar opalescence or glare when cut and polished *en cabochon.*

A polished specimen in the University collection from the Western Districts of New South Wales weighs 1·2636 grammes, and has a specific gravity of 2·6703 at 18·5° C.

The Oriental Cat's-eye, of Ceylon, is a variety of chrysoberyl, and is distinguished by its much higher specific gravity, which is about 3·7 to 3·9

Opal.

This mineral consists of silica, with usually from 5 to 12 per cent. in water.

Precious or *Noble Opal.*—The precious opal of New South Wales has the milky body colour usually possessed by this mineral, and the same brilliant play of colours ; the dominant colours of the scintillations are metallic green, pink, and red. Some of the best specimens form, when polished, very fine gem-stones ; but here as elsewhere the valuable specimens obtained bear but a small proportion to the whole. The best have been obtained from Rocky Bridge Creek, Abercrombie River, county Georgiana ; the matrix is a fine-grained bluish-grey amygdaloidal trachyte, some 30 feet thick, which is so much altered that it can be abraded by the thumb-nail ; the opal has filled by infiltration certain of the vesicular cavities and crevices in this rock ; it is associated with much common opal free from any play of colour and hyalite.

Some cut and polished specimens of opal from Trunkey were found to have the following specific gravities :—

No. 1	weighing	·3610	gramme	had	a specific	gravity of	2·1488	at 17° C.
No. 2	,,	·1146	,,	,,	,,	,,	2·1300	at 18° C.
No. 3	,,	·1860	,,	,,	,,	,,	2·1703	at 17° C.

The appearance and mode of occurrence of the opal found at Bulla Creek, in Queensland, is very different ; the body colour of the Queensland opal is usually deep ultramarine blue or green, and the reflections are usually metallic green and red ; the matrix is in this case a brown mottled clay porphyry, in which the opal occurs as small veins and strings. This variety of opal occurs for the most part in films too thin to cut, *en cobochon*, but it yields beautiful specimens when cut as cameos.

Opal is also found in a similar clay porphyry in the Wellington District; but up to the present I have only seen small particles of the precious opal diffused through much valueless opal; it also occurs at Louisa Creek, at Bland, near Forbes; at Coroo, with chalcedony, agates, &c.; and at Bloomfield, near Orange.

Fire Opal or *Girasol*—(*i.e.*) an opal with a red or orange tint—occurs at Wellington. Of no value hitherto.

Specific gravity of one specimen, 2·106.

Common Opal, *semi-opal*, and *wood opal* are common in all the basaltic districts, usually of pale shades of pink, brown, green, and varying from translucent to opaque; Louisa Creek, Tambaroora, Lowee, Carwell; Uralla, in the county of Sandon; Inverell, county of Gough; Richmond, Hunter, Lachlan, and Castlereagh Rivers; Trunkey and Cowra, county of Bathurst; Kiama, county Camden; Hookanvil Creek, below Hanging Rock; Home Rule and Gulgong, county Phillip; Wellington, county Wellington; at O'Connell, county of Westmoreland, there is a vein running through silurian slates; Carcoar, Cowra, Cobar, Braidwood; on Lawson's Creek, a tributary of the Cudgegong River.

Cacholong.—A specimen of opaque porcelain—white cacholong passing into white opal, with conchoidal fracture. Adhering strongly to the tongue. Hardness, 5–6. From the Tumut River, county Selwyn. It was found to have the following composition:—

Specific gravity, 1·884.

Analysis.

Water lost at 105° C.	2·553
,, combined	5·185
Silica	88·811
Alumina and traces of iron sesquioxide	1·206
Lime	1·134
Carbonic acid	traces
Magnesia	·485
Loss	·626
	100·000

Hyalite.—Muller's glass.

Found coating the joints in basalt, Jordan's Hill, Cudgegong, county Phillip; of a blue colour at Ororal.

*Siliceous Sinter.**—Most of the specimens of this material which I have had the opportunity to examine exhibit many of the appearances which are usually presented by the deposit thrown down from hot springs or geysers.

Although no such hot springs or geysers are known to exist at the present day in the Colony, yet I understand from Mr. W. Wilson, of Monaltrie, to whom I am indebted for my specimens, that the district in which they occur presents many features which lead him to consider that it had been the scene of comparatively recent (*i.e.*, in a geological sense) active volcanic phenomena.

The district has not, I believe, been examined in detail by any trained and experienced geologist; but, judging from Mr. Wilson's account, it must be one of remarkable interest.

Basaltic and trachytic rocks are the principal surface rocks occurring in the neighbourhood. The basalt is remarkable for containing very large and well-developed amygdaloids of chalcedony, agate, arragonite, and certain of the commoner zeolites. Of the amygdaloidal and other minerals, together with specimens of the matrices, Mr. Wilson sent a large series to the Commissioners for the Philadelphia Centennial Exhibition—the collection of which must have entailed the expenditure of much time and labour.

* Fossiliferous Siliceous Deposit from the Richmond River, N.S.W. By A. Liversidge. *Journal of the Royal Society of N.S. W.*, 1876, p. 237.

In the interior of the mass the siliceous deposit is usually of a more or less pale wax colour, and in certain respects closely resembles *wood opal*. Wood opal is actually present, and in parts, streaks of common opal occur. Occasionally, on breaking open a specimen, jet black patches are met with; the colouring matter apparently contains carbon, as it is slowly burnt off before the blow-pipe flame.

On the surface the mineral weathers white, and the decomposition passes in to a depth of from ¼ to ½-inch.

It adheres strongly to the tongue.

Weathered portion.

Analysis.

Moisture, given off at 100°	4·16
Combined water (loss on ignition)	1·78
Insoluble silica	89·74
Soluble silica	·47
Alumina and iron sesquioxide	1·13
Lime	·48
Magnesia	1·98
Loss	·26
	100·00

Specific gravity, 2·046 at 66° Fah.

Unweathered portion.

Analysis.

Water, given off at 100°	4·08
Combined water (loss or ignition)	·58
Insoluble silica	91·67
Soluble silica	·30
Alumina and iron sesquioxide	1·56
Lime	·36
Magnesia	·55
Loss	·90
	100·00

Specific gravity, 2·330 at 66° Fah.

The composition shows that it answers to the common siliceous sinters or geyser deposits.

It will be seen that the weathered specimen has a lower specific gravity and contains rather more water, also more lime and magnesia.

In places the structure is more or less distinctly lamellar, evidently due to the manner of its deposition in successive layers. The fracture is more or less distinctly conchoidal across the planes of deposition, but where the lamellar structure is less strongly marked, or altogether obliterated, the fracture is conchoidal in all directions.

The weathered surface is usually marked with the remains of ferns, which stand well out in relief; with the ferns and stems are the fruit and seeds of other forms of vegetable life.

Within the substance of the mass occasional layers of a brilliant white colour are met with, and along these layers it splits into flakes and slabs with ease; these white layers are much softer than the other portions, and they are found to be composed almost exclusively of the casts of vegetable tissue; the fern fronds and stems are especially well preserved; also scattered irregularly through these layers and the solid substance of the mineral the remains of certain fruits and seeds are met with, belonging to a new genus (*Liversidgea.* F. von Mueller).

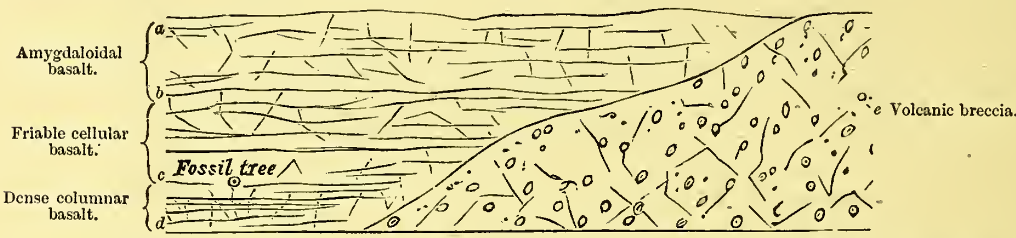
Silicified Wood.—Is very abundant over nearly all the basaltic districts. Much of it has doubtless been derived from trees overwhelmed by old lava flows. The remains of these trees have become silicified, and have since, by the disintegration and removal of the enveloping rock, been set free as "fossil wood."

The following note* upon a specimen of partially fossilized wood may help to show how this has been brought about :—

The specimen forming the subject of this note was found by Mr. C. S. Wilkinson, F.G.S., at Inverell, where the Macintyre River has cut through the basalt and formed a river cliff; by the formation of this section the included fragments of wood and trunks of trees are exposed to view.

In the *Mines and Mineral Statistics*, published by the Mining Department in 1875, Mr. Wilkinson gives the following description of the manner in which the fossilized wood occurs, and on the same page (p. 76) he gives a diagram showing the position occupied by the particular tree trunk from which this specimen was taken :—

"An interesting cliff section of basalt may be seen on Mr. Colin Ross's property on the bank of the river at Inverell. The following is a sketch of it :—



"*a*, *b*, amygdaloidal basalt, much decomposed ; *c*, friable cellular basalt, enclosing frag ments of wood and pieces of earth ; *d*, dense columnar basalt ; *e*, volcanic breccia, composed of fragments of basalt of various sizes embedded in an indurated volcanic mud, much stained with peroxide of iron, which imparts to the rock varying shades of deep red and yellow. This breccia is older than the *a b c d*, and evidently formed the side of a hill on which plants were growing at the time of the basalt eruption ; for at the junction of the basalt and breccia lies a thin bed of red clay, the former surface soil, in which I discovered numerous stems of plants. Some of these stems are in an upright position, and even penetrate a few inches into the basalt rock above, and several I found with the woody matter but little altered. These facts are very singular, as proving the viscid state of the overflowing basaltic lava, to have thus surrounded the small plants without destroying them, and how rapidly it must have cooled. Another interesting relic of the newer pliocene period that this section reveals is the trunk of a tree, about 2 feet in diameter, embedded in the layer of basalt marked *c* in the above sketch.

"The wood, though much changed, yet retains its fibrous structure most completely. It somewhat resembles the stringy-bark, and may possibly be a species of eucalyptus ; but this is difficult to decide without the aid of the microscope.

"Surrounding the tree is a soft substance 2 inches thick, which was probably the bark."

As pointed out by Mr. Wilkinson, the woody structure has not been destroyed, and it is still visible to the unassisted eye, but with the aid of a microscope the structure of the cellular tissue is much more clearly seen ; patches of white carbonate of lime and of yellow oxide of iron are also observed deposited within its substance.

The specimen seems to have been considerably crushed and broken ; in general appearance it looks as if a number of angular fragments of charcoal had been pressed together. This brecciated structure was probably set up after the trunk was enveloped by the fluid lava, and was doubtless caused by the contraction of the rock round the wood, as it solidified and cooled.

When heated in a closed tube much water is given off ; when ignited on platinum foil it does not inflame or glow like a carbonaceous substance, but quickly burns to a pale brownish-grey ash ; the carbon, which has apparently been converted into graphite, is present in very small quantity, and barely sufficient to impart a black colour to the substance.

It effervesces with acids, is fragile, and sufficiently soft to be scratched with the thumb-nail.

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* "On the Composition of some Wooden closed in Basalt." By A. Liversidge. *Journal of the Royal Society of N.S.W., 1880.*

Analysis.

Water lost at 100° C.	12·54
Combined water—by direct weighing	·46
Silica	35·57
,,	·31
Carbon	5·14
Iron sesquioxide	1·76
,, protoxide	3·67
Manganese	traces
Alumina	15·79
Lime = (16·42. $CaCO_3$)	9·20
Magnesia = (7·24. $MgCO_3$)	3·45
Potash	·22
Soda	·27
Sulphur	traces
Sulphuric acid	traces
Carbonic acid	11·29
Loss	·33
	100·00

The lime and magnesia evidently exist as carbonates; a small quantity of the protoxide of iron may also exist in combination with carbonic acid, as there is ·28 per cent. of carbonic acid left after converting all the lime and magnesia into carbonates. The alumina and iron probably exist in the form of silicate, as the amount of silica is nearly sufficient to form a silicate of the formula R_2O_3, $3SiO_2$, or if the water also be taken into account, $Al_2O_3 3SiO_2 + 4H_2O$.

As it contains traces of sulphur and of sulphuric acid, small quantities of iron pyrites are probably present.

The combined water was determined by heating the powdered substance in a combustion tube and collecting the water in a weighed chloride of calcium tube, and the carbon by combustion with lead chromate in a current of oxygen, the silica by fusion with the mixed alkaline carbonates, and the alkalies by Dr. J. Lawrence Smith's process with calcium carbonate and ammonium chloride.

Masses of silicified wood are very common in nearly all basaltic areas over all parts of the world, and they are very noticeable in many parts of this Colony; this particular specimen is different from the above, inasmuch as, instead of being composed almost exclusively of silica or of hydrated silica, as is the case with ordinary silicified wood, it has been mineralized by a mixture of various substances.

On account of the mineralized wood having such a complex constitution, it may be thought that it may have been merely replaced mechanically—*i.e.*, it might be supposed that the wood has been burnt or rotted away and the mould left by it filled in with earth and charcoal, but such is not the case. There is no doubt that the mineral matter has been deposited from solution; the woody tissue, which was doubtless much charred, has been almost completely replaced particle by particle, by the deposition of mineral matters from infiltered water holding them in solution. This process must have been a very slow one; the cavities of the cells were probably filled first, the cell walls were next gradually removed, except those portions represented by the small remaining quantity of graphite-like carbon, and replaced by mineral matter as the decay went on, but so slowly and quietly that no violence was done to the microscopic structure of the woody tissue."

Silicified wood is very abundant also throughout the coal measures. Large boulders of such fossilized wood are met with in most of the drifts and river deposits.

Tripoli or Infusorial Earth.—Abundant in several places in the Colony, notably at Barraba, where it is made up almost entirely of the remains of diatoms resembling *melosira.*

A specimen of tripoli, supposed to be meerschaum, obtained about 40 miles from Tamworth, gave Mr. Dixon the following results:—

Analysis.

Water	12·84
Silica	80·56
Alumina	4·15
Oxide of iron	1·77
Carbonate of calcium	·31
,, magnesium	·21
Alkaline salts, and loss	·16
	10·000

Class V.

Anhydrous Silicates.

Wollastonite.—Tabular Spar.

Chem. comp.: A silicate of lime. $CaSiO_3$. Oblique system. Found at Duckmaloi with garnets and epidote.

Chrysolite.—Peridot, Olivine.

Chem. comp.: Magnesium silicate. Rhombic system. Transparent bright green coloured specimens of chrysolite are common in most of the gold drifts. Found in the Shoalhaven and Hunter Rivers; Louisa Creek; Old Trigomon. Associated with the various gems in Gt. Mullen Creek, which falls into the Cudgegong, county Phillip; also at Two-mile Flat; Bingera, county Murchison; and other places. The exterior often has a white opaque enamel-like crust.

Augite.—Pyroxene.

Chem. comp.: A silicate of magnesia, iron, lime, &c. Oblique system. There are several varieties of augite, which range from white, or almost white, to dark green, black, and opaque minerals.

Well-formed short columnar crystals of augite are not uncommon. They are abundant at Cameron's Creek, county of Hardinge; and Newstead and Middle Creeks, county of Gough; near Guntawang, county of Phillip; Pretty Plains, near Molong; and near to the Pigeon House. At Bruno waterfall, Callalia Creek, with mesotype and arragonite in a vesicular and amygdaloidal basalt, which rests upon columnar basalt. Found at Barraba, county Darling; and Murrurundi, county of Brisbane.

A specimen from Oberon, of a green colour, more or less decomposed, only traces of the previous crystallization left. Soft and fragile. Collected by Mr. C. S. Wilkinson, F.G.S. Was found to have the following composition:—

Analysis.

Water lost at 100°C.	·210
Silica	35·319
Alumina	5·922
Iron sesquioxide	28·557
,, protoxide	1·809
Manganese protoxide	4·056
Lime	22·751
Magnesia	absent
Potash	·378
Soda	·221
Loss and undetermined	·777
	100·000

Specific gravity, 3·48.

Chondrodite.—Said to occur at Gulgong, county Phillip.

Specific gravity, 3·349.

Smaragdite, containing native copper, occurs in a hard elvan porphyry at Molong Creek, county Ashburnham; and near to Dowagarang (the Old Man Canobolas), county Wellington.

Diallage.

Chem. comp.: Calcium and magnesium silicate. Occurs in small bronze-green coloured crystals in the serpentine of Bingera, county Murchison; Warialda, county Burnett; and Kelly's Creek, Gwydir River, with chrome iron. Also, at Bowling Alley Point, near Tamworth, county of Parry, with bronzite. The crystals are thin, translucent, and more or less brittle.

Hypersthene.

Chem. comp.: Calcium, magnesium, and iron silicate. An outcrop of a hypesthene rock is said to occur near the Lagoons, west of Gulgong, and Cooma, county Beresford.

Diaclasite, from Bingera, county Murchison.

Bronzite, associated with small, colourless garnets, crystallized in rhombic-dodekahedra, and Saussurite, occurs near Nundle and Tamworth.

Hornblende.—Amphibole.

Chem. comp.: Magnesium, calcium, iron, manganese, silicate. Oblique system. Different varieties of hornblende vary extremely in colour, form, and composition.

1. *Tremolite.*—A white or nearly white variety occurs, at Cooma, in long slender crystals.
2. *Actinolite.*—A dark green fibrous actinolite occurs at Mowembah; in quartz at Giant's Den, Bendemeer; also in quartz at Merrendee, on the Meroo Creek, a tributary of the Cudgegong. Large radiate groups occur at Cow Flat, near Bathurst; also at Manar and Jejedzeric Hill.
3. *Sahlite.*—Crystals of this form are said to occur in a compact augite paste on the Cowridga Rivulet and near Scone.

A light grey, sub-translucent hornblende mineral was collected by Mr. C. S. Wilkinson, F.G.S., at Mount Walker, on the Mudgee Road, which breaks in places something like a very fine grained quartzite or jade, with somewhat conchoidal surface; in other places there is a fibrous structure due to the presence of bright acicular crystals. The weathered portions are stained brown with oxide of iron, and show the cavities left by fossils. It seems to have been highly charged with the shells of spirifera.

Partly soluble in acid.

Extremely tough. Hardness, 6–7. Specific gravity, 3·003.

Analysis.

Loss on ignition	·60
Silica	50·44
Alumina	6·19
Iron sesquioxide	1·25
Lime	28·70
Magnesia	11·14
Soda	1·16
Loss	·52
	100·00

The sedimentary rock in which the fossils were originally embedded must have been highly metamorphosed to account for the present character of the matrix. This has been brought about by the intrusion of a vein of igneous rock at the spot. The formula is practically $2\ (\frac{2}{3}\ CaO \frac{1}{3}\ MgO)\ 3\ SiO_2$. Physically this mineral resembles pectolite; but in chemical composition it is more closely related to some of the hornblende group.

Large crystals of common hornblende occur at Uralla, county Sandon; Tenterfield, county Clive; in the New England District, and in other places. In quartz with lamellar magnetite, at Merrendee, on the Meroo, a tributary of the Cudgegong, and on the road from Jungemonia to Uranbeen, county Phillip; also at Cooma, county Beresford; Bendemeer, and Cope's Creek.

4. *Asbestos* (Amianthus).—Chem. comp.: Essentially a magnesium silicate. A fibrous variety of hornblende.

Localities.—Said to occur in veins at Bukkulla, county Arrawatta; Guyong, county Bathurst; and Burraba Creek, county Wellington; in the basalt at Pennant Hills, county Cumberland; with auriferous quartz in diorite at Gulgong, King's Plains, county of Phillip; also at Wentworth, county of Wentworth; Lucknow Gold-field, Icely, Trunkey, Caloola, and Mount Lawson, in the county of Bathurst; Lewis Ponds Creek, county Wellington; the Lachlan River; Briar Park, Sewell's Creek, near Rockley, with marmolite and schiller spar in serpentine, and Abercrombie Range, county Georgiana; Carangara; and Jones' Creek, near Gundagai, county Clarendon. Abundant at Cow Flat Copper-mines, but not of the best quality; with serpentine, Briar Creek, Campbell River. The asbestos from near Gundagai appears to be found in long silky white fibres, and is apparently of very good quality.

A dark, olive-green coloured, and imperfect asbestiform mineral, from near Cow Flat, was found to have the following composition:—

Specific gravity, 3·02.

Analysis.

Hrgroscopic water	1·084
Combined	1·941
Silica	49·447
Alumina	9·688
Iron sesquioxide	16·330
Iron protoxide	5·151
Manganese protoxide	4·389
Magnesia	traces
Lime	11·970
	100·000

The value of the asbestos raised in the Colony of New South Wales during 1881 and previous years is given at £2,728 14s. (*Annual Report of the Mining Department,* Sydney).

Kyanite.—Disthene.

Chem. comp.: Aluminium silicate. Anorthic system. Occurs near to Kangaloolah, an arm of Tuena Creek, some 10 miles south of Tuena, and at Bingera. In colour it is nearly white, the lustre pearly, in slender flattened brittle crystals.

Staurolite.

Chem. comp.: Aluminium silicate. Rhombic system. Occurs in a talcose schist near Bathurst, in the form of small brown prismatic crystals.

Andalusite.

Chem. comp.: Aluminium silicate. Rhombic system. A vein of this mineral, crystallized in rhombic prisms of a pinkish-grey colour, is said to occur in the slate rock to the east of Bungonia.

Chiastolite, a variety of Andalusite.—Chem. comp.: Aluminium silicate. Rhombic system. Occurs in granite rock, at Arnprior, Boro, near Goulburn, and in small imperfect crystals in the slate near Modbury, Shoalhaven; and near Tumut, in a dark-coloured micaceous slate or schist.

Zoisite.—Found at Avisford, county of Wellington.

Epidote.

Chem. comp.: Silica, alumina, lime, iron, etc. Oblique system.

Occasionally well-developed columnar crystals have been met with, but I have seen none of large size—also massive. Usually various shades of green.

Epidote is found on Diamond Hill, Sidmouth Valley, in altered silurian schist, near to its junction with diorite and granite, in association with wollastonite, garnets, specular iron ore, brown hæmatite, and black oxide of manganese.

With garnets at Duckmaloi in wollastonite.

Found in the Murrumbidgee District, near Mount Tennant; at Gorce, near Mudgee; at Bundian, with glassy felspar and quartz; at Manilla, county of Darling; at Oberon county Westmoreland; the Windindingerie Cataract; Jejedzerick; between Jingery, Bobbera, and Pambula, county of Auckland; the "Gap," Lewis Ponds, county of Wellington; the Shoalhaven River, county St. Vincent; to the east of Bungonia, county Argyle; Gulgong, county Phillip; Bathurst; and in the bed of the Gwydir River and of the Ora Ora.

Tourmaline.—Schorl.

Chem. comp.: Very complex, but mainly composed of silicate of alumina, iron, lime, and soda, with usually some 3 or 4 per cent. of boracic acid; other substances such as lithia are often present.

Crystallizes in the hexagonal system, usually in the form of prisms having a more or less triangular section, and strongly striated parallel to the principal axis. Large prisms are met with in the New England District, and also in the Murrumbidgee. When the crystals are small and more or less aggregated together into bundles, the mineral is termed schorl; this form of it is common in the granite of the New England tin district, at Bendemeer, Bulanamang, and in veins and nests in granite, with large mica crystals, at Wombat, near Young.

Large crystals are found in the South with pegmatite between Mowwat and Burramungee; with tremolite at Jejedzeric in granite; at Tarcutta, county Wynyard.

It is also commonly found associated with gold, diamonds, and other gems in drifts and river deposits, more or less rolled; at times all trace of the original crystallized form is removed.

Large crystals of tourmaline at Oban, county of Clark; Balala; Cooma, county Beresford; Orara; at Albury and Mount Tennant; in laminated granite, at Oura, in the Wagga Wagga District.

Felspar Group.

Orthoclase.—Common Felspar.

Chem. comp.: Aluminium and potassium silicate. Oblique system. There are several varieties of this mineral: *Common* or *Orthoclase Felspar* includes all the common non-transparent varieties; *adularia*, the sub-transparent forms; opalescent adularia is termed *moonstone;* and *glassy felspar*, or *ice spar*, comprises the clear and transparent forms.

Fine well-formed crystals of felspar have not yet been obtained here, although fairly large and moderately well-developed crystals are not uncommon in the coarse-grained granites of the New England, Bathurst, and Southern Districts. Simple and compound crystals of an inch or so in length, exposed by weathering, are common in the granite of New England. Dark grey felspar at Mount Walker. At Lawson's Creek in fairly well formed large isolated crystals, and at Oban, county of Clarke; Balala, in the county of Hardinge; and in large crystals on the Cudgegong River, and at Home Rule, county of Phillip. Medium sized crystals of *glassy* felspar are reported at Benada Creek, also near Naas, county Cowley, and with quartz at Lanyon to the west of Mount Tennant. Again near "The Pass" Bundian. With mica chlorite and quartz at Windindingerie Cataract. Acicular crystals of glassy felspar occur in compact felspar at Mount Wingen near the burning coal seam, county Brisbane.

A porphyry occurs near Tumut, in which red and white felspar crystals are diffused through a dark green felspathic paste; this rock would form a very attractive ornamental stone.

Crystallized adularia felspar is plentiful on Mount Lindsay.

Albite.

Chem. comp.: Aluminium, sodium and potassium silicate. Doubly oblique system.

Occurs massive and in the form of white crystals in New England, as at Bingera, county Murchison; also in one or two places near Gulgong, county Phillip, at one of which it is said to be found in association with calcite, opal, asbestos, epidote, sphærosiderite, mispickel, blende, galena, pyrites, and copper pyrites in an auriferous vein traversing a diorite; at Rylstone, county of Roxburgh. It occurs crystallized with translucent quartz at Mount Dixon, Dewelamble, Murrumbidgee, and with quartz, chlorite, and green mica on the Coolalamine Plain and at the head of the Yarralumla.

Oligoclase.

Chem. comp.: Aluminium, sodium, and calcium silicate. Doubly oblique system.

Reported by Mr. Wilkinson in basalt with olivine and augite at Collingwood, and in the Lachlan and Fish Rivers.

Nepheline.

Chem. comp.: Aluminium, sodium and potassium silicate.

Hexagonal system. Occurs in amygdaloidal porphyry between the "Pinnacle," county Forbes; Dowagarang, and the Old Man Canobolas, near Wellington, county Wellington.

Spodumene.

Chem. comp.: Aluminium and lithium silicate. Oblique. Mr. Wilkinson reports its probable occurrence at Oura Station, near Wagga Wagga, county Wynyard.

Hauyne.

Chem. comp.: Silica, alumina, soda, lime, and sulphuric acid. Cubical system.

The Rev. W. B. Clarke discovered some small specimens of a blue-coloured mineral which he believed to be hauyne, below the Windindingerie Cataract, in association with flesh-coloured felspar, adularia, quartz, and epidote.

Mica.

Muscovite.—Potash Mica.

Chem. comp.: Aluminium and potassium silicate. Oblique system.

Large tabular crystals of mica are met with in the coarse-grained granite of the Bathurst District, as at Broadwater and other places on the Macquarie River, and at Cooma and Wheeo, county Beresford; crystals of a golden-coloured mica are also obtained from the same place, and at Orange with crystals of felspar in a pink-coloured granite.

Green mica is common in the granite of New England; the mica entering into the composition of the greisen at Elsmore, and Newstead, county Gough, and other places is greenish. Green mica also occurs in the granite of Yarrangun and Ororal.

In the Naas Valley, county Cowley, mica is found in large crystals, associated with quartz, felspar, hornblende, tourmaline, and chlorite.

A mammillated bright golden-coloured mica is found in white quartz at Kiandra, county Wallace: this has very much the appearance of rolled gold, for which in fact it has been mistaken; yellow mica also occurs in Frazer's Creek, county Arrawatta.

A bright-coloured mica with silvery lustre is met with in a manganiferous cement at Buckley's Lead, Two-mile Flat, county Phillip.

Large groups of beautiful plumose crystals of mica occur at Oura Station, Wagga Wagga, county Wynyard.

Class VI.

Hydrous Silicates.

Prehnite.

Chem. comp.: Hydrous silicate of alumina and lime. Rhombic system. Occurs at Emu Creek, New England, of a green colour; and, in association with orthoclase felspar and copper ores, at Reedy Creek, county Murchison; Molong, county Ashburnham; also at Prospect Hill, county of Cumberland.

Gismondine.—A hydrated calcium-aluminium silicate, crystallizing in rhombic forms resembling the tetragonal pyramid, present with other zeolites in the Murrurundi Tunnel.

Allophane.

Chem. comp.: Hydrous silicate of alumina, Al_2O_3, SiO_2, $6H_2O$. Occurs as amrorphous masses and incrustations of a bluish and opaque white colour at the Great Blayney Coppermine, near Blayney, associated with native copper. The surfaces are mammillated in part.

Zeolite Group.

This group of minerals is distinguished by the property which most of them possess of fusing with intumescence before the blow-pipe, *i.e.*, they boil up, the name being derived from ζέω, to boil, and λίθος, a stone. They are usually found filling the amygdaloidal cavities, and crevices in igneous rocks, and never as crystals disseminated through the mass of the rock like pyrites, garnet, or mica. In chemical composition they consist essentially of compound hydrated silicates of alumina, the alkaline earths and alkalies; and when treated with acids gelatinous silica is separated.

Zeolites are found at Muswellbrook, county of Durham; on the Conical Hills, Bando Plains; and with green earth at Wallabadah, county of Buckland. Also near Tamworth, Murrurundi, Prospect Hills, Parramatta River—in fact, wherever there are more or less decomposed amygdaloidal rocks.

Thomsonite.

A hydrous calcium-aluminium silicate, crystallizing in the rhombic system.

Comptonite.—A variety of Thomsonite, found at Dabee, county of Phillip.

Stilbite.

Chem. comp.: Hydrous silicate of alumina and lime. Rhombic system. Reported to occur in metamorphic silurian shales at Adelong, county Wynyard; and at Gunnedah, county Pottinger; and in the neighbourhood of Tamworth.

Heulandite.

Chem. comp.: Hydrous silicate of alumina and lime. Oblique system.

Found at Hartley county of Cook; in small red crystals, seated on a bluish grey schistose rock or slate.

Laumonite.

Chem. comp.: Hydrous silicate of alumina and lime. Oblique system. This mineral occurs in the form of white crumbly prismatic crystals in association with black and white parti-coloured calcite crystals in the cavities of an amygdaloidal rock on the road between Geringong and Kiama, county Camden.

This mineral was also observed by Mr. C. E. Wilkinson, the Government Geologist, and obtained by him from a cutting on the Bathurst Road, near the Cox River.

It occurs as small irregular veins, of a pleasing salmon-colour, running through a soft bluish-grey shale; the veins together with the included plates of shale are sometimes 6 inches thick, but usually smaller; the actual veins of the mineral itself being only about $\frac{1}{8}$th of an inch thick. Some difficulty was on this account experienced in obtaining sufficient of the sample pure enough for analysis.

Translucent; lustre, pearly.

The mineral appears to be partially crystallized; nothing definite could be made out, but some of the confused crystals had somewhat the appearance of rhombic prisms. It apparently cleaves parallel to the long axis, and less perfectly at right angles to it.

Specific gravity, 2·5. Hardness, about 2·5, can be crushed by the thumb nail, being very tender. Streak, pink, but paler than the mineral itself.

Heated in the closed tube it gives off water, and at a red heat becomes grey, but re-acquires a pink colour on cooling, which is rather paler than the original colour. On platinum foil, when strongly heated, it fuses to a whitish mass. Does not impart any distinctive tint to outer flame. With nitrate of cobalt gives a blue colour. Soluble in HCl with separation of much gelatinous silica.

Analysis.

Combined water	12·646
Silica	53·266
Alumina and traces of iron	22·833
Lime	11·000
Magnesia	·479
	100·224

It also occurs as a white powdery mineral in a soft grey-coloured amygdaloidal trachytic rock at Myralla. This mineral may at once be recognised by its tendency to decompose.

Apophyllite.

Found on the Talbragar River, in the county of Bligh; and in the Murrurundi Tunnel, county of Brisbane.

Chem. comp.: A hydrated calcium silicate, containing potassium fluoride. Crystallizes in the tetragonal system.

Natrolite.—Mesotype.

Chem. comp.: Hydrous silicate of alumina and soda. Rhombic system.

In radiate groups of long acicular crystals; found in amygdaloidal basalt in the Murrurundi Tunnel, county Brisbane; and near Inverell, county Gough.

Scolezite.

Same chem. comp. as the above. Rhombic system. This mineral is found with cylindrical masses of bitter spar in a basalt, Emu Creek, New England. It is distinguished by curling up like a worm before the blowpipe—hence the name, from σκώληξ, a worm.

Analcime.—Cubical Zeolite.

Chem. comp.: Hydrous silicate of alumina and soda. Cubical system. Occurs at Inverell, county of Gough.

Analcime in grey amygdaloidal rock, with laumonite and apophyllite, on the Talbragar River, county of Bligh.

Chabasite.

Chem. comp.: Hydrous silicate of alumina, lime, and potash. Hexagonal system; commonly assumes rhombohedral forms. This is perhaps the most abundant of the New South Wales zeolites, and the crystals are often very well developed. It occurs in basalt with delessite at Muswellbrook, county Durham; and in well-formed rhombohedra in trachyte on the Lachlan River; also in an amygdaloidal basalt at Reedy Creek, Sutton Forest, county Camden; with calcite in a similar rock at Coroo. In the Murrurundi Tunnel, with other zeolites, in a decomposing amygdaloidal rock, also halloysite associated with a nepheline basalt; also near Tamworth, in amygdaloidal cavities with other zeolites. It also occurs in the cavities of a puce-coloured rock at Fountain Head in simple rhombohedral crystals of a wax-yellow colour, and is associated with a bright orange-coloured powdery mineral and a grey-green steatitic substance; the matrix can be readily cut with a knife, and leaves a shiny streak.

It is also reported from the Talbragar, county Bligh, and Abercrombie Rivers, county Georgiana, and is present in the basalt of the Illawarra District.

Gmelinite.—This is one of the chabasite group, and occurs, crystallized in double hexagonal pyramids, with calcite and analcime, at Inverell, county Gough.

The name of Herschellite has been given to this mineral both in Victoria and New South Wales.

A specimen from Inverell, crystallised in double hexagonal pyramids, of a cone-like appearance, from the faces merging one into the other. Transparent and colourless to opaque white. Dr. Helms, of the University of Sydney, has analysed this specimen with the following results:—

Specific gravity, 2·100.

Analyses.

	No. 1.	No. 2.	Mean.
Water at red heat	20·67	......	20·67
Silica	47·59	47·81	47·70
Alumina	19·51	19·06	19·31
Lime	10·83	10·87	10·85
Magnesia	·36	·50	·43
Potash	1·15	1·21	1·18
Soda	·29	·49	·39
			100·53

Corresponding to the formula $CaOSiO_2$, $Al_2O_33SiO_2$, $6H_2O$.

The composition is really that of chabazite, hence it was quite unnecessary to make the new species for some time known as Herschellite.

In amygdaloidal rock, in the Murrurundi Tunnel, with laumonite, &c.; also near Tamworth.

An account of some Zeolites and other minerals from New Holland is given by F. Alger in "Silliman's American Journal of Science for 1840," but no information is given as to the localities, hence the paper is not so valuable as it otherwise would have been.

Serpentine Group.

There are several varieties of the mineral serpentine met with in New South Wales. The rock of the same name is also found very largely developed, both in the Northern, Western, and Southern Districts.

Serpentine.

Chem. comp.: Hydrous silicate of magnesia.

Of an oil-green colour, semi-transparent, on the Murrumbidgee; at Bingera, county of Murchison; Warialda, county of Burnett; Barraba, Manilla, county of Darling; and Stony Batta, county of Hardinge. Different varieties of red-veined serpentine, steatite, and other similar minerals are reported in the Upper Peel River.

It also occurs at Coolac and Jones's Creek, near Gundagai, county of Clarendon, and on the Clarence River.

Williamsite.—Apple-green, translucent, somewhat greasy to the touch, takes a very fair polish, and forms very pleasing ornamental stone. H. = 3.

From Tuena, county Georgiana.

Marmolite.—A foliated variety of serpentine occurs on the Murrumbidgee, of a yellowish colour, associated with dull-red and green serpentine rock, and at Cowarbee, 40 miles from Wagga Wagga, with leaf gold. (See p. 66.)

The late Mr. Stutchbury mentions the occurrence of an orbicular serpentine on the Apsley, Manning, and Hastings Rivers or Creeks.

Marmolite, schiller spar, and asbestos occur in serpentine on the Peel, county of Parry.

Picrolite.—Chem. comp.: Hydrous magnesium silicate.

A fibrous variety of serpentine. Found at Kelly's Creek, Gwydir River, and in the serpentine at Bingera, county Murchison, with meerschaum. It occurs also as a green striated mineral at Lucknow, county Wellington, and Wentworth, near Orange, county Bathurst.

Talc.

Chem. comp. : Hydrous magnesium silicate. Hexagonal system.

Occurs in the form of hexagonal crystals between Gudgeby River and Naas Valley, county Cowley; also about Bathurst. And between Jungemonia and Uranbeen with steatite and large hornblende crystals.

Steatite.—A massive indurated form of talc or hydrous magnesium silicate, near Cow Flat, county Bathurst.

Occurs in Ranger's Valley, Severn River, county Gough, at Elsmore, and the Bolitho Tin-mine, associated with tin-stone. At Jungemonia and Uranbeen, Icely, and Trunkey, county Bathurst; and Sewell's Creek, county Georgiana.

Soapstone, Saponite.—Williams River, Icely, and Lowee.

Agalmatolite, or Chinese Figure Stone.—In chlorite schist. Nurembla, Callalia Creek.

Meerschaum.—Chem. comp. : Hydrous magnesium silicate. Said to occur near Bingera and on the Richmond River. All the specimens of so-called meerschaum which I have yet seen from the latter district have proved to be cimolite, hence the statement requires confirmation.

Chlorite.—Green earth.

Chem. comp. : Hydrous silicate of alumina and magnesia, with more or less oxide of iron.

In a confused mass of various crystallized substances, Gulgong, Lachlan River; on Pine Ridge, Copperhannia Creek, in an auriferous quartz reef; Queanbeyan, Yass. With a white crystalline marble, near Wagga Wagga.

De Lessite.—A ferruginous chlorite. Its occurrence is mentioned by the Rev. W. B. Clarke. It is found with chabazite in basalt, near Muswellbrook.

A pink schistose mineral was found embedded in the slates and other rocks at the S.E. corner of Rocky Ridge, by the late Dr. Thomson, Professor of Geology in the University of Sydney, and Mr. Norman Taylor.*

The mineral is somewhat friable, earthy and meagre to the touch; emits an argillaceous odour when breathed upon; adheres to the tongue; is decomposed by hydrochloric acid with separation of granular silica; yields a very pleasing bright pink-coloured powder; before the blow-pipe does not fuse, but darkens slightly; heated in a tube it evolves moisture, darkens, but re-acquires its original colour on cooling. As the mineral is evidently only a non-crystallized decomposition product it is unnecessary to give it a name; it is therefore provisionally placed with the chlorite group.

Analysis.

Water lost at 105° C.	1·335
Silica	61·951
Alumina	24·120
Iron protoxide	1·222
,, sesquioxide	3·400
Lime	7·850
Magnesia	trace
Loss	·122
	100·000

Pinite.

The following account of a mineral occurring in serpentine at Hanging Rock is by Mr. W. A. Dixon, F.C.S. (*Report of the Department of Mines*, Sydney, 1879). "It is massive, translucent, with a sea-green colour, waxy lustre, and unctious feel; gives a white streak and powder. In a sealed tube it gives off water and becomes white; before the blow-pipe it is infusible, but becomes opaque and reddish-white, and is not acted on by hydrochloric acid.

Hardness, 2; specific gravity, 2·68.

* The "Mudgee Diamond-fields," by Thomson and Taylor. *Jour. Roy. Soc., N.S.W.*, 1869.

Analysis.

	No. 1.	No. 2.
Silica	35·72	36·10
Alumina	38·60	38·41
Oxide of Iron (Fe O)	8·64	......
Magnesia	5·40	5·64
Lime	·61	......
Water	10·96	......
	99·93	......

The mineral seems to be new, and the ratio of the oxygen in $\dot{R}$ $\ddot{R}_2$ $\ddot{S}i$ $\dot{H}$ is 1 : 4·2 : 4·5 : 2·3, which would give a formula approximating to = 4 ($\dot{F}e$ $\dot{M}g$ $\dot{C}a$) 6$\ddot{A}l$, 9$\ddot{S}i$, 9$\dot{H}$."

Although the mineral does not quite agree with any of the pinites, yet it should doubtless be classed with them.

Clays.

Kaolin, or China Clay.—Is derived from the decomposition of granite, and is not uncommon in many parts of the Colony. A deposit of kaolin suitable for the manufacture of the best porcelain is reported to occur at Lambing Flat, King's Plains, county Bathurst; and another of a dazzling white colour on a hill near to Rocky Ridge, which is in association with a bright and pretty coloured lavender clay derived from decomposed basalt; also found near Barraba, county Darling.

In the *Philosophical Transactions of the Royal Society of London* for 1798 there is an account of an earthy substance by Mr. Charles Hatchett, brought from Sydney by Sir Joseph Banks, and variously named *Sydneia*, *Australa*, *Terra Australis*, and *Austral Sand.* The substance is of no importance, but there is a certain amount of interest attached to the paper, since it contains probably the first analyses of any mineral from this Colony.

It had previously been examined in 1790 by the celebrated Mr. Wedgwood*, also by Professor Blumenbach, of Göttingen, by Dr. Klaproth, and by Professor Haidinger, of Vienna.

One of the specimens consisted of "a white transparent quartzose sand, a soft opaque white earth, some particles of white mica, and a quantity of dark lead-grey particles, which have a metallic lustre."

Sydneia.

Analyses.

No. 1.		No. 2.	
Silica	·30	Silica and mica	77·75
Silica combined	75·25		...
Alumina	7·20	Alumina	6·50
Oxide of iron	3·20	Oxide of iron	3· 0
Graphite or plumbago	10·25	Plumbago	10· 0
Water	2·20		...
	98·40		97·25

As the result of his examination Mr. Hatchett came to the conclusion that the substance had been derived from a decomposed granite, and recommended the removal of Sydneia from the list of minerals, since it did not contain any new primitive earth, nor did it possess the characteristic properties previously ascribed to it.

Cimolite.—There is a deposit of very white and porous hydrous silicate of alumina † on the Richmond River, which has often been sent down to Sydney as meerschaum. Probably this is partly due to its low specific gravity, for when first immersed it floats upon the water. It sometimes contains leaf impressions; colour, dead white; breaks with more or less well marked conchoidal fracture; shows traces of stratification; very porous, and adheres strongly to the tongue; hardness, 2—2·5; can be scratched by the thumb-nail, and leaves a mark on cloth, but not readily.

* *Phil. Trans.*, vol. lxxx (1790), part ii, p. 306.

† The so-called meerschaum from the Richmond River.—A. Liversidge, *Jour. Royal Society of N. S. W.*, 1876, p. 240.

The specific gravity after immersion in water for some time is 1·168.

Before the blow-pipe it blackens slightly at first, and becomes harder after ignition; it is infusible, and yields a blue mass when ignited after moistening with cobalt nitrate; this at once distinguishes it from meerschaum, which would under those circumstances afford a pale pink coloured mass.

Analysis.

Water, given off at 100°	3·28
Combined water (loss on ignition)	4·34
Insoluble silica	51·35
Soluble silica	·11
Alumina	37·72
Iron sesquioxide	·46
Lime	·34
Magnesia	1·25
Alkalies	traces
Carbonic acid	1·54
	100·39

The low specific gravity is very characteristic of this mineral, but in other respects it answers to the mineral *cimolite.*

Fire Clays.—Of good quality are common throughout the coal measures; and in the shales, claystone nodules which would probably yield high-class cement are plentiful.

Brick Clays.—Large deposits of clay, which burn to red, white, and intermediate colours, are common in the county of Cumberland, derived from the disintegration of the Wianamatta shale.

Halloysite.

Chem. comp.: Hydrous silicate of alumina.

This is an amorphous earthy mineral, resembling steatite, derived from the decomposition of igneous rocks. Adheres to the tongue, can be scratched and polished by the nail; of various colours—black, brown, grey, green, and red; the black often contains small brilliant white veins. When placed in water the mineral usually falls to pieces, and the edges become translucent.

Specimens of black halloysite are from time to time brought from various parts of the Colony as samples of graphite.

A specimen collected by Mr. C. S. Wilkinson, F.G.S., from near Berrima, had the following properties and composition:—Black, black streak on paper; somewhat greasy feel; does not adhere to the tongue; soft, readily scratched by nail, leaving shiny streak; brittle; conchoidal fracture.

Analysis.

Water lost at 105° C.	3·047
,, combined	12·840
Silica	45·289
Alumina	38·547
Lime	trace
Loss	·277
	100·000

Pale green and white halloysite occur in decomposing amygdaloidal rocks, with zeolites, in the Murrurundi Tunnel, county Brisbane.

Occurs in a railway cutting through decomposed basalt containing chabasite at Reedy Creek, county Murchison; and Stony Creek, county Wynyard; Sutton Forest, county Camden; at Two-mile Flat, county Phillip, of a pretty green colour; Carcoar, county Bathurst; and on the Lachlan River.

Class VII.

Gem Stones.

Corundum.

There are several forms of this substance—alumina. The blue is known as the sapphire, the green as the oriental emerald, the red as the ruby, the hair-brown as adamantine spar, the magenta-coloured us barklyite, and the common dark-coloured ones as corundum and emery. Corundum is said to occur in basalt at Bald Hill, Hill End, county Wellington, with olivine.

The rolled pebbles of corundum from the Diamond Drift on the Cudgegong River were found by Dr. A. M. Thomson to have a specific gravity of only 3·21 to 3·44; but with a hardness of 9 as usual.

Sapphire.

Chem. comp.: Alumina or aluminum sesquioxide, Al_2O_3. Hexagonal system. The usual forms met with in New South Wales are double pyramids, sometimes combined with the basal pinakoid; the prism is less common. Perfect crystals are, however, rare, the majority of the specimens being either fractured or waterworn. There appears to be no record of their having been found *in situ.* In certain cases it would appear from their sharp and unworn edge that they had not travelled very far

H = 9. Specific gravity = 3·49 to 3·59.

The New South Wales sapphires, in common with those from other parts of Australia, are usually rather dark in colour; they however, are found varying from perfectly colourless and transparent, through various shades of blue and green, to a dark and almost opaque blue. One or two green-coloured sapphires or oriental emeralds are almost always met with in every parcel of a hundred or so specimens, also blue and white particoloured.

Asteria or sapphires which show a six-rayed star of reflected light are by no means uncommon.

Sapphires are almost invariably met with by the miners as an accompaniment of alluvial gold.

Thcy are widely distributed over the New England District, as at Bingera, county of Murchison; and near Inverell, Rose Valley, Swanbrook, Vegetable Creek, and Newstead, county Gough, with tin, adamantine spar, zircons, topaz, and bismuthite; in Cope's Creek, county Hardinge; Oban, county Clarke; Nundle Creek and Peel River, county Parry; Dundee, Ben Lomond, Mann's River, Gwydir River; in the county of Sandon, at Uralla; on the Namoi River; on the Abercrombie River; blue and green sapphires near Mount Werong, with pleonaste, zircons, gold, &c., county of Georgiana; on the Cudgegong River, county Phillip; at Two-mile Flat, Bell's River, and Pink's Creek, county Roxburgh, with white topaz, almandine garnets, epidote, spinelle, chrysoberyl, chrysolite, hyacinth, &c.; at Tumberumba, county Wynyard, with tinstone and other minerals; in the Shoalhaven River, county St. Vincent; and the Snowy River, county Wallace.

Blue and green sapphires are found with gold, zircons, and other gems, on Native Dog Creek, an eastern branch of Sewell's Creek, Oberon District.

Some specimens of cut and polished sapphires were found to have specific gravities as follows:—

	Weight.	Sp. gr.	Temperature.
No. 1. Royal blue colour	·1400 gramme	4·1170	at 18° C.
,, 2. Dark ,, ,, ...	·2332 ,,	4·2326	,, 18°
,, 3. ,, ,, ,, ...	·4776 ,,	3·9115	,, 16°
,, 4. ,, ,, ,, ...	·6488 ,,	3·9404	,, 19°
,, 5. Four small dark sapphires ...	·5050 ,,	4·1124	,, 18·5
,, 6. Five ,, ,, ,, ...	·6255 ,,	4·0225	,, 17·5
,, 7. One large ,, ,, ...	·9738 ,,	4·0206	,, 17·5
,, 8. Oriental emerald	·9674 ,,	4·0041	,, 19°
,, 9. ,, ,, ...	·5996 ,,	4·0733	,, 18·5

The late Dr. A. M. Thomson, Professor in the Sydney University, detected a variety peculiar to the Mudgee District, which occurs in uniformly small slightly barrel-shaped hexagonal crystals of about $\frac{1}{4}$-inch long and $\frac{1}{20}$-inch diameter—opaque, and of a peculiar lavender colour, with a few dark blue spots. He made out the composition as follows :—

Analysis.

Alumina	98·57
Iron sesquioxide	2·25
Lime	·45
	101·27

H. = 9. Specific gravity = 3·59.

Ruby *or* Red Sapphire.

This is much more rare than the blue gem. The late Mr. Stutchbury reports its occurrence with sapphire, chrysolite, hyacinth, amethyst, and other gems in the Cudgegong between Eumbi and Bimbijong, and in Mullen's and Lawson's Creeks, county Phillip, which fall into the Cudgegong. And the Rev. W. B. Clarke found it at Tumberumba, county Wynyard, with similar gems. It is found, too, at Mudgee, but is not common, and usually of small size; also from a small creek, about 2 miles from the head of the Hunter River, as well as in the Peel River. Dr. Thomson determined the composition, hardness, and specific gravity of a specimen from Two-mile Flat to be as follows :—

Analysis.

Alumina	97·90
Iron sesquioxide	1·39
Magnesia	·63
Lime	·52
	100·44

H. = 9. Specific gravity = 3·59.

Barklyite.—This name has been given in Victoria to the more or less opaque magenta-coloured variety. A specimen from Two-mile Flat, uncut, weighing ·5884 gramme, had a specific gravity of 3·7382 at 18°5 C.

Adamantine Spar.

The brown variety of Alumina. Found at Two-mile Flat, county Hardinge; Uralla, county Sandon; Bingera, county Murchison; and Inverell, county Gough.

Some cut and polished specimens of adamantine spar were found to have a specific gravity of 4·0306 at 17°C.

When cut and polished *en cabochon* this forms a very handsome ring stone.

Emerald.—Beryl.

Chem. comp.: Silicate of aluminium and glucinium. Hexagonal system.

The name emerald is usually reserved for the deep green coloured stones fit for jewelry, while the less beautiful and pale varieties are termed beryls.

The emerald is said to occur mixed with granite detritus in Paradise Creek, county Gough, and near Dundee. Also in gneissiform dykes on the summit of Mount Tennant, and at Lanyon to the west of that mountain; in the granite at Cooma; and in Mann's River and Kiandra with other gems. In some cases the beryl is probably meant.

The beryl is much more common. It is found at Elsmore associated with quartz and crystals of tinstone. The beryl crystals, which are often very thin and fragile, are seen interlaced with, and seated upon, the crystals of tinstone.

At Ophir, county Wellington, the beryl occurs in white felspar with quartz and white mica; one crystal from Ophir, $\frac{5}{8}$-inch through, of a pale transparent yellow-green colour and vitreous lustre, had a specific gravity of 2·708.

A greenish-coloured opaque beryl in small hexagonal prisms has been found in the Shoalhaven River east of Bungonia; the crystals are associated with mispickel, and in some cases they penetrate it.

A specimen of beryl from Australia was examined by Schneider (Ramm. Min. Ch. p. 555, and quoted in *Dana's Descriptive Mineralogy*, p. 247), and found to have the following composition:—

Analysis.

Silica	67·6
Alumina	18.8
Beryllia, or Glucina BeO	12·3
Iron sesquioxide	·9
	99·6

CHRYSOBERYL.—Cymophane.

Chem. comp.: Glucinium aluminate, BeO, Al_2O_3. Rhombic system.

The late Mr. Stutchbury mentions that he found a fragment of this gem in the Macquarie River.

ZIRCON.—Hyacinth, Jacinth, or Jargoon.

Chem. comp.: Zirconium silicate, $ZrSiO_4$. Pyramidal system.

The transparent red varieties are known as hyacinths, the smoky as jargoons; while the grey, brown, etc., are known as zircons.

This mineral is found in granite on the Mitta Mitta, and on the Moama River, some 4 miles west of Jillamalong Hill, county Cadell.

Zircons are very common in the auriferous river sands and drifts, as at Uralla, county Sandon; Bingera, county Murchison; the Cudgegong River, county Phillip; the Macquarie River; the Abercombie River, county Georgiana; the Rocky River and Two-mile Flat, county Hardinge; the Shoalhaven River, county St Vincent; they are common, with iron pyrites, in the granite on which Kiandra is built; on the Talbragar River, county Bligh.

They are of course usually more or less rolled, but occasionally the crystalline form is well preserved; they vary much in colour, from more or less colourless and transparent through pale-red to crimson, brown, and opaque; they are also found of a clear transparent green, but these are rarer than the others.

Dr. Helms kindly examined for me some specimens in the form of small rolled pebbles, of good colour, fairly transparent, fit to cut, and obtained the following results:—

Specific gravity, 4·675.

Analysis.

Silica	32·99
Zirconia, ZrO_2	66·62
Iron sesquioxide	·43
Lime	·14
	100·18

The above corresponds to the formula $ZrSiO_4$ or ZrO_2SiO_2.

When cut and polished some of the New South Wales zircons form very beautiful gem stones of a hyacinth red colour. The following determinations of the specific gravities were made upon such specimens:—

Cut and polished	·3118 gramme in weight	Sp. gr. = 4.7822 at 18°C
,, ,,	·4023 ,, ,,	,, ,, = 4·697 ,, 17°C
,, ,,	1·8145 ,, ,,	,, ,, = 4·7191 ,, 18·5C
Uncut	2·4580 ,, ,,	,, ,, = 4·6838 ,, 17·5C

Topaz.

Chem. comp. : Alumina, silica and fluorine. Rhombic system. Occasionally met with in well-formed columnar crystals capped with planes of numerous pyramids. Some of the crystals are perfectly clear, colourless, and transparent. Some very large crystals have been met with ; a portion of a large bluish green-coloured crystal found at Mudgee, and now in the Melbourne Technological Museum, weighs several pounds ; and others weighing several ounces are by no means rare ; they are sometimes 2 to 3 inches long, and broad in proportion, especially those from Uralla.

A specimen of clear, transparent, pale purple topaz, from New England, weighing 4oz., was found to have a specific gravity of 3·5.

One found at Gundagai of a pale blue green tint, measured 3 by 1½ inches with a weight 11oz. 5dwts. Another of a similar colour from Gulgong weighed 18oz. avoirdupois; unfortunately it had been broken into two pieces.

The pale bluish-green tint is the most common colour; sometimes they are slightly yellow.

The specific gravities of two cut and polished specimens of colourless topaz from the New England District were determined as follows :—

No. 1.	Weight = 1·523 gramme	....	Sp. gr. = 3·5666 at 17°C
No. 2.	,, = 11·6010 ,,	....	,, ,, = 3·5640 ,, 19°C

It is comparatively abundant all over the granite region of New England ; it occurs associated with tinstone in veins traversing the eurite, greisen and granite near Elsmore and other parts ; some of the small crystals found with the tin ore are beautifully developed.

Found also on Glen Creek, Scrubby Gully, Vegetable Creek, and near Inverell, county of Gough ; Dundee ; Oban, county Clarke ; Balala ; Bingera, county Murchison ; Two-mile Flat, county Hardinge ; Bathurst, county Bathurst ; Bell River, county Roxburgh ; Macquarie and Lachlan Rivers ; the Shoalhaven and Abercombie Rivers.

Spinelle.—Spinel Ruby.

Chem. comp. : Magnesium aluminate, $MgAl_2O_4$. Cubical system. Small well-formed octahedra are by no means rare ; the colour varies from pale brown, red, deep crimson, green, to black, when it is known as pleonaste.

It is found in most river deposits containing gold, as in the sands of the Severn and its tributaries, at Uralla, county Sandon ; Bingera, county Murchison ; at Werong with gold, zircons, blue and green sapphires, and other gems ; Two-mile Flat, county Hardinge ; Bathurst, Macquarie, Peel, and Cudgegong Rivers.

Spinel is said to occur in the sandstone on the road near the Fitzroy Iron-mines, Nattai.

W. B. Clarke also mentions occurrence of minute spinel rubies in carboniferous sandstone at Kayon, Richmond River ; but states that they are probably derived from the igneous rocks of which most of the beds in the Richmond River District are the recomposed materials.

Pleonaste.—Fairly well-formed large crystals of pleonaste with well-marked conchoidal fracture are found in the Lachlan River. One fairly well-formed octohedron, from the Muntabilli River, Monaro District, was remarkable for its channelled faces.

The amorphous black vesicular pleonaste occurring on the Mudgee Diamond-fields was examined by the late Dr. A. M. Thomson ; who found it to have the following composition :—

Analysis.

Silica and undecomposed	2·75
Alumina	64·29
Sesquioxide of chromium	4·62
Magnesia	21·95
Protoxide of iron	4·49
	98·10

Specific gravity = 3·77. Hardness, 8.

The colour is dull black, the surface vesicular ; no cleavage, but a highly lustrous well-marked conchoidal fracture ; streak, grey.

Garnet.

Chem. comp.: There are several kinds of garnet, and they vary in composition, but the most common are silicates of alumina, lime, iron, manganese, and other bases.

Cubical system: The rhombic dodekahedron and the ikositetrahedron are the most common forms here as in other parts of the world.

It is the alumina-lime or common garnet which is most generally met with, especially in the granite ranges, as at Hartley, county Cook; it is found also at Bingera, county Murchison; Pond's Creek, and other places near Inverell, county of Gough; at Uralla, county of Sandon; in a talc schist at Bathurst, Trunkey Creek, and Coombing Creek Copper-mine, in the county of Bathurst; with mica schist in Washpool Creek, county Drake; on the Abercrombie River, county Georgiana; in the county of Cadell, on the Old Trigomon, Moama River, 4 miles west of Jillamalong Hill, with hyacinth and gold; at Hardwicke, near Yass, county of King; red translucent garnets are found at Gulgong, county Phillip; and in Sidmouth Valley.

The garnets from Duckmaloi are dull brown and crystallized in combinations of the rhombic dodekahedron and ikositetrahedron, with large irregular crystals of epidote, in association with wollastonite in schist.

A dark greenish-brown garnet occurs in large quantities, with magnetic iron ore, at Wallerawang, well crystallized in rhombic dodekahedra.

Small colourless crystals and massive garnet with a variety of diallage or bronzite occur near Tamworth.

Small brown garnets crystallized in rhombic dodekahedra occur in a mica schist near Sofala.

Andradite, *Common Garnet*, Lime-iron Garnet.—Found associated with magnetite at Wallerawang; of a brown colour, rather dull. Crystallized in rhombic dodekabedra. The composition of the massive garnet is given under the head of Magnetite,* the mineral with which it is associated. The following shows the composition of the crystals:—

Analysis.

Hygroscopic moisture	·322
Carbonic acid	1·982
Silica	34·164
Alumina	3·251
Iron sesquioxide	29·435
,, protoxide	·931
Manganese protoxide	·553
Lime	28·303
Magnesia	absent
Potash	·341
Soda	·186
Loss	·532
	100·000

Grossularite.—Lime alumina garnet.

From near Mudgee; of a rich dark brown colour; translucent. Imperfectly crystallized in groups of large rhombic dodekahedra.

Analysis.

Silica	40·517
Alumina	19·906
Iron sesquioxide	·285
,, protoxide	3·165
Manganese protoxide	3·700
Lime	32·245
Magnesia	traces
Carbonic acid	·254
	100·072

Idocrase.

Said to occur in the Snowy Mountains with epidote, diopside, and garnets.

* See p. 104.

LIST OF MINERAL LOCALITIES IN NEW SOUTH WALES.

For the reasons given at the beginning of this paper, the following list of localities for minerals must be regarded as only provisional; in many cases the minerals probably do not occur at the place itself, but are found somewhere in the neighbourhood.

Argyle.

Bangalore, Goulburn Plains	Marble.
Boro Creek	Pisolitic iron ore, wad.
Brooks' Creek	Diamond.
Broulee	Iron ores, silver, zinc blende.
Brunaby Creek	Silver ores.
Bullio Flat	Molybdenite.
Bungonia	Alunogen, andalusite, antimonite, copper ores, epidote, galena, gypsum, pharmacosiderite, pisolitic iron ore, plumbago, tinstone.
Currawang	Copper ores.
Goulburn	Galena, gold, mispickel.
Inverary	Magnetite.
Long Gully	Tinstone, wad.
Made Hill	Pisolitic iron ore.
Major's Creek	Zinc blende.
Marulan	Coal, marble, mispickel.
Murrumbateman	Marble.
Nerrimunga	Copper ores.
Spring Creek	Tinstone.
Turalla Creek	Lignite.
Windellama Creek	Pisolitic iron ore.
Wollondilly River	Copper ores.
Yarralumla	Albite.

Arrawatta.

Bukkulla	Asbestos, coal.
Brush Creek	Websterite.
Severn River	Spinelle.

Ashburnham.

Burra Burra	Goethite, magnetite, tin.
Canobolas	Copper.
Canomidine Creek	Copper ores, marble.
Canowindra	Gold.
Cargo	Copper ores, gypsum, gold.
Carrawabbity	Marble.
Currajong (12 miles from)	Copper ores, gold.
Forbes	Copper ores.
Forbes (near)	Marble.
Gobolion	Jasper.
Molong	Copper ores, jasper, lead, prehnite.
Molong Creek	Copper ores, smaragdite.
M'Guiggan's Lead	Gold.
Parkes	Calcite, copper, gold.
Peabody Mine	Copper ores.
Pretty Plains	Pyroxene.
Smith's Paddock	Copper ores.
Wapping Butcher Mine	Gold.

Auckland.

Bobbera, Jingery, and Pambula (between).	Epidote.
Brogo and Twofold Bay (between).	Bog Butter.
Chonta	Lignite.
Eden	Antimonite, gold.
Frog's Hole	Copper ores, calcite.
Merimbula	Galena, gold.
Pambula	Graphite.
Twofold Bay	Antimonial copper ore.

Bathurst.

Back Creek	Goethite.
Bathurst	Copper, diamond, epidote, garnet, gold, iron pyrites, jasper, marble, osmium-iridium, pyromorphite, spinelle, staurolite, talc, tinstone, titaniferous iron, topaz.
Bathurst (near)	Amethyst, antimonite, copper-nickel, gypsum, silver ores, wad.
Bathurst Road	Wad.
Belubula River	Magnetite, marble, gold.
Blayney	Copper (native and ores), allophane, hæmatite.
Brown's Creek	Gold, magnetite, copper ores.
Caloola	Asbestos, braunite, pyrolusite, wad, gold, hæmatite.
Carcoar	Chalcedony, copper ores, eisenkiesel, gold, hæmatite, halloysite, iron pyrites, magnetite, marcasite, mispickel, opal.
Coombing Creek	Copper ores, garnet, kupfermangerz.
Copperhannia	Copper ores, chlorite, gold.
Cow Flat	Actinolite, asbestos, copper ores, galena, steatite, zinc blende, marble.
Cowra	Copper ores, opal.
Cowridge Creek	Agate, chalcedony, sahlite.
Diamond Hill	Epidote.
Glanmire	Manganese.
Icely	Asbestos, copper, epsomite, soapstone, steatite.
Kaizer Mine	Copper ores, chessylite, gold.
King's Plains	Asbestos, kaolin, gold.
Milbura Creek	Copper ores.
Mount Grosvenor	Galena, silver.
Mount Lawson	Asbestos.
New Summer Hill	Argentiferous galena.
Ponsonby Parish	Hæmatite, copper ores.
Reedy Creek	Diamond.
Rockly (5 miles W. of)	Manganese, hornblende.
Sidmouth Valley	Garnet, gold, copper ores, manganese, epidote.

Bathurst—*continued.*

Summer Hill	Hæmatite.
Summer Hill Creek	Gold.
Teesdale	Silver.
Waroo	Galena.
Wentworth	Picrolite, gold, mispickel, magnetite.
Whet Creek	Gold.
Winter & Morgan's Mine	Silver (native), gold, copper ores, barytes, pyromorphite, galena.
Wood's Flat	Gold, limonite.

Beresford.

Cooma	Emerald, gold, gypsum, hypersthene, muscovite, tourmaline, tremolite.
Wheeo	Copper ores, muscovite. chrysocolla.

Bland.

Bland	Opal.
Calabash Creek	Diamond.
Humbug Creek	Gold.
Temora	Gold, copper ores, galena.
Woodstown	Gold.

Blaxland.

Boona West	Tinstone.
Eremeran	Tinstone.
Mount Hope	Copper ores.

Bligh.

Balara	Copper ores.
Cudgegong River	Gold, diamond, &c.,
Munmurra	Wulfenite.
Talbragar River	Analcime, apophyllite, chabasite, titaniferous iron.
Tallawang	Gold.

Bourke.

Cowabee	Gold.
Mandama West	Pyrites.

Brisbane.

Inverleigh	Coal.
Isis River	Galena, silver ores.
Kingdon's Ponds	Wulfenite.
Mount Agate	Agate.
Mount Wingen	Agate, alunogen, limonite, magnetite, orthoclase, sulphur, wulfenite.
Murrurundi	Pyroxene, torbanite, zeolites, carnelian, agate.
Murrurundi Tunnel	Apophyllite, chabasite, gismondine, gmelenite, halloysite, natrolite.
Page River	Galena, limestone, silver ores.

Buccleuch.

Darbarra Parish	Tinstone.
Lob's Hole	Arragonite, calcite, copper ores.
Tumut	Hæmatite, gold.
Yarrangobilly	Copper ores, gold.

Buckland.

Carroll's Creek	Tinstone.
Quirindi Creek	Tinstone.
Wallabadah	Copper, galena, marble, zeolites.

Buller.

Bookookoorara	Tinstone.
Boonoo Boonoo	Gold, tinstone.
Boorook	Silver ores, gold.
Herding Creek	Tinstone, gemstones, etc.
Maryland Creek	Tinstone, gemstones, etc.
Ruby Creek	Tinstone, gemstones, etc.
Ruby Tin-mine	Tinstone, diamond, gemstones, etc.
Undercliff	Tinstone.
Wylie Creek	Tinstone, gemstones, etc.
Tooloom River	Coal, gold.

Burnett.

Warialda	Diallage, serpentine.

Camden.

Atkinson's Mine	Coal, hæmatite.
Berrima	Coal, goethite, halloysite, limonite, torbanite.
Broughton Creek	Torbanite.
Broughton Vale	Goethite.
Bulli	Coal, limonite.
Burragorang	Epsomite, galena, limestone, torbanite.
Cambewarra Ranges	Torbanite.
Colo Gates	Coal.
Cordeaux River	Graphite.
Gerringong	Laumonite.
Gibralta Rock	Alunogen.
Jamberoo	Chalybite, chert, goethite, coal.
Jordan's Crossing	Coal.
Joadja Creek	Coal, jet, torbanite.
Kiama	Agate, amethyst, copper, laumonite, opal.
Macquarie Valley	Gold.
Minumurra Creek	Coal.
Mittagong	Coal, goethite, iron ores.
Mount Keira	Coal, goethite, iron ores, graphite.
Mount Kembla	Coal, torbanite.
Mount Pleasant	Coal, iron.
Nattai	Coal, goethite, hæmatite, limonite, pisolitic iron ore, pleonaste.
Picton	Salt.
Saddleback	Torbanite.
Shell Harbour	Gold.
Sutton Forest	Chabasite, halloysite, hæmatite.
Wingecarribee River	Coal.
Wollondilly	Marble, limestone.
Wollongong	Calcite, coal, limestone.

Clarence.

Clarence River	Antimonite, apatite, coal, copper ores, goethite, magnetite, reisnite, serpentine, silver ores.
Grafton	Antimonite, chromite, gold, magnetite.
Nana Creek	Gold, pyrites.
Orara	Epidote, tourmaline.
Tea-tree Creek	Tinstone.

Clarendon.

Bethungra	Galena.
Coolac	Serpentine.
Eurongilly	Gold.
Gundagai District	Antimonite, asbestos, braunite, copper ores, goethite, gold, lölingite, manganese, minium, native lead, topaz, marble.
Jones' Creek	Asbestos, calcite, serpentine.
Junee District	Gold, limestone.
Kimo	Gold, copper ores.
Oura	Schorl, muscovite, spodumene.
Sebastopol Reef	Galena, gold.
Wantiool	Gold.

Clarke.

Aberfoil	Antimonite.
Mount Mitchell	Antimonite, tin.
Oban	Cairngorm, molybdenite, orthoclase, sapphire, tinstone, topaz, tourmaline.
Sara River	Tinstone.

Clive.

Byrne's Lode	Native bismuth.
Deepwater Creek	Tinstone, gemstones, &c.
Mole River	Tinstone, gemstones, &c.
Mole Tableland	Tinstone, gemstones, &c.
Sandy Mount	Tinstone.
Tenterfield	Antimonite, gold, hornblende, native bismuth.

Cook.

Bathgate	Torbanite.
Blackheath	Goethite, torbanite.
Blue Mountains	Wad, limonite, graphite, chert, hæmatite.
Bowenfels	Coal, gold, limonite.
Eskbank	Coal, hæmatite.
Govett's Leap	Gold (traces), wad.
Gow's Creek	Fluor-spar.
Hartley	Chert, galena, garnet, heulandite, hæmatite, jet, torbanite, gold.
Katoomba	Wad. Coal, torbanite. (See Blue Mountains.)
Lithgow Valley	Coal, goethite, limonite.
Milalong	Coal.
Mount King George	Goethite.
Mount Lambie	Fluorspar, hæmatite, limonite, magnetite, garnet.
Mount Megalon	Coal.
Mount Tomah	Goethite.

Cook—*continued.*

Mount Victoria	Chert.
Mount Wilson	Oligoclase.
Mount York	Coal, torbanite.
Mudgee Road	Alunogen.
New Bridge	Goethite.
Vale of Clwydd	Coal, gold pyrites.
Walker's Crossing	Iron pyrites.
Wallerawang	Alunogen, andradite, antimonite, chert, coal, epsomite, garnet, goethite, limestone, limonite, magnetite, marble.
Wolgan	Gold, coal.

Cooper.

Narrandera	Goethite.

Cowen.

Coonabarabran	Bitumen.

Cowley.

Cavan	Limestone.
Coodrabidgee River	Arragonite.
Cotta River (near)	Copper ores.
Gudgeby River (near)	Talc.
Naas Valley	Muscovite, orthoclase.

Cumberland.

Appin	Alunogen, epsomite.
Bulli	Alunogen, coal, hæmatite.
Cataract River	Arragonite, calcite.
Coal Cliff	Coal, limonite.
Manly Beach	Hæmatite.
Parramatta River	Lignite, zeolites.
Pennant Hills	Asbestos, calcite.
Pittwater	Alunogen.
Port Hacking	Arragonite, goethite.
South Creek	Coal.
Sydney	Hæmatite.
Windsor	Pisolitic iron ore.

Dampier.

Dena River	Gold.
Montreal	Gold.
Moruya	Arsenic, mercury, zinc blende, gold.
Moruya River	Galena, mispickel, silver ores, gold.
Mount Dromedary	Gold.
Nerrigundah	Gold.
Wagonga	Mercury.

Darling.

Barraba	Chromite, copper ores, gold, kaolin, magnetite, pyroxene, serpentine, tripoli.
Manilla	Calcite, copper ores, epidote, serpentine.
Manilla River	Copper ores, iron pyrites.
Mount Lowry Creek	Tinstone.
Namoi River	Iron pyrites.
Nangahra Creek	Tinstone.
Tiabundii Creek	Tinstone.

Drake.

Cangai	Gold.
Drake	Antimonite, cervantite.
Fairfield	Gold, tinstone.
Lunatie	Antimonite, native arsenie, gold.
Plumbago Creek	Graphite (plumbago).
Solferino	Antimonite, eerussite, eopper, galena, gold, magnetite, roek crystal.
Timbarra	Gold.
Tooloom	Gold.
Washpool Creek	Antimonite, garnet.

Dudley.

Caragula	Antimonite, eervantite.
Kempsey	Antimonite, barytes, cervantite, marble.
Munga Creek	Antimonite, cervantite.
Warrill	Antimonite, silver ores.

Durham.

Calton Hill	Platinum, native silver.
Dungog (near)	Gold.
Gresford	Antimonite, eervantite.
Muswellbrook	Chabasite, De Lessite, zeolites.
Paterson River	Antimonite, eervantite, silver ores.
Rix Creek	Coal, iron.

Evelyn.

Grey Ranges	Gypsum.
Mount Brown	Gold.

Farnell.

Mount Arrowsmith	Gypsum, agatc.
Mount Lyell	Copper ores.

Forbes.

The Pinnacle	Nepheline, gold.
Wangajong	Gold.

Georgiana.

Abererombie River	Apatite, barytes, chabasite, diamond, garnet, graphite, sapphire, topaz, zireon, gold.
Abererombie Ranges	Asbestos.
Abereombie Caves	Marble.
Briar Park	Asbestos, copper ores.
Crookwell River	Copper and silver ores.
Grove Creek	Mereury.
Jones' Mount	Copper ores.
Kangaloola Creek	Kyanite.
Mount Werong	Pleonaste, sapphire.
Peelwood	Antimonite, cerussite, eopper ores, galena, minium, molybdenite.
Roekley	Marble.
Rocky Bridge Creek	Barytes, ehalybite, opal.
Sewell's Creek	Asbestos, sapphire, steatite.
Thompson's Creek	Copper ores.
Trunkey	Agate, asbestos, diamond, opal, tale, steatite, gold, marble.
Tuena	Cerussite, copper ores, gold, williamsite.

Gipps.

Condobolin	Copper ores.
Forbes (50 miles W. of)	Iron ores.
Lake Cowal	Gold.

Gloucester.

Bowman River	Gold.
Baek Creek	Mispickel, gold.
Cooloongoolook	Gold.
Port Stephens	Marble, coal.
Stroud	Gold.
Williams River	Soap-stone, gold.
Gloueester	Coal.

Gordon.

Buckinbar	Copper, silver ores.
Gooderieh	Copper, molybdenum, gold.
Billy's Look-out	Gold.

Gough.

Albion Mine	Rock erystal, tinstone, wolfram.
Bald Nob Creek	Steatite.
Bruee Mine	Native bismuth.
Byron's Plains	Cairngorm, augite.
Dundee	Copper ores, emerald, mispickel, plumbago, sapphire, tinstone, topaz.
Elsmore	Copper ores, emerald, fluorspar, mispiekel, molybdenite, muscovite, native bismuth, tinstone, wolfram, beryl.
Glen Creek	Galena, tinstone, topaz, wolfram, wood-tin.
Glen Innes	Native bismuth.
Invcrell	Adamantine spar, agate, analeime, arragonite, augite, copper ores, galena, gmelenite, opal, sapphire, silicified wood, tinstone, topaz, wolfram, olivine.
Kingsgate	Molybdenum, native bismuth, tinstone.
Lamb's Paddoek	Fluorspar.
Middle Creek	Cairngorm, diamond, pyroxene, tinstone, sapphires, and other gems, fluorspar, galena.
M'Intyre River	Cairngorm, tin.
Newstead	Chalcedony, chalybite, diamond, limestone, molybdenite, museovite, pyroxene, rock erystal, sapphire, tin, wolfram.
New Valley	Graphite, tinstone.
Paradise Creek	Emerald.
Pond's Creek	Bismuthite, garnet, tin, topaz.
Ranger's Valley	Cairngorm, steatite, tinstone.
Redgate	Native bismuth.
Rose Valley	Sapphire, tinstone.
Shannon River	Tinstone.
Shannon Valley	Tinstone.
Sheep Station Creek	Tinstone.
Silent Grove Creek	Native bismuth, tinstone.
Spring Creek	Tinstone.
Stoekyard Creek	Tinstone.
Swan Creek	Tinstone.
Vegetable Creek	Diamond, monazite, native bismuth, sapphire, tinstone.
Yarrow River	Tinstone.

Goulburn.

Albury	Gold, pyrites.
Copobella	Copper ores.
Jingellic Creek	Tinstone.

Gresham.

Ann River	Tinstone.
Henry River	Tinstone.
Mitchell River	Tinstone, gold.
Nymboi River	Carnelian, gold.

Hardinge.

Auburn Vale Creek	Tinstone.
Balola	Orthoclase, topaz, tourmaline.
Bengonover Mine	Diamond, tinstone and gem-stones.
Bolitho Mine	Tinstone.
Borah Mine	Diamond, tin.
Bundarra	Tinstone.
Cameron's Creek	Pyroxene.
Cope's Creek	Diamond, fluorspar, hornblende, rock crystal, sapphire, tinstone, tourmaline, topaz, galena.
Honey's Creek	Tinstone.
Honeysuckle Creek	Tinstone.
Kentucky Ponds	Tinstone.
Made Hill	Pisolitic iron ore.
Moredun Creek	Tinstone.
Rocky River	Antimonite, gold, magnetite, tin, titaniferous iron, zircon.
Sandy Creek	Tinstone.
Sandy Swamp	Galena.
Smashem's Creek	Tinstone.
Stony Batta Creek	Chromite, serpentine.
Swan Creek	Tinstone.
Swinton Parish	Tinstone.
Tingha	Bismuthite, galena, tin, copper ores.
Two-mile Creek	Iron ores.

Hunter.

Capertee	Calcite, gold.

Harden.

Binalong	Magnetite.
Bogolong	Magnetite.
Bookham	Galena, hæmatite, marble.
Cootamundra	Wad.
Hall's Creek	Wad.
Jugiong Creek	Galena, magnetite.
Murrumburrah	Galena, gold.
Mylora	Galena, hæmatite, gold.
Muttama	Gold.
Wombat	Gold.

Inglis.

Bendemeer	Hornblende, manganese, platinum, sapphire, tinstone, tourmaline.
Carlyle's Creek	Tinstone.
Peel River	Copper ores.
Tamworth	Gmelenite, goethite, gold, manganese, zeolites.
Woolomi	Chromite, jasper.
Attunga	Tinstone.

King.

Bala	Copper ores.
Bowning Creek	Copper and silver ores.
Burrowa	Copper ores, galena.
Burrowa Creek	Silver ores.
Crookwell	Galena.
Dalton	Gold, pyrites.
Derringellon Creek	Copper ores.
Good Hope Mine	Lead ores, fluorspar.
Gunning	Copper ores, gold.
Hardwicke	Garnet.
Pudman Creek	Galena.
Silverdale	Cerussite, copper ores, galena, fluorspar, wad, zinc blende, marble.
Sharpening-stone Creek	Antimonite.
Yass	Chlorite, chromite, copper ores, galena, gypsum, magnetite, rock crystal, wad.
Yass Plains	Marble.
Yass River	Silver ores.
Weeho	Gold.

Lincoln.

Barbigal	Coal, iron ores.
Dubbo	Agate, amethyst, chalcedony.
Dunedoo	Gold.
Mitchell's Creek	Gold, copper.

Macquarie.

Hastings River	Antimonite, marmolite.
Kempsey (near)	Marble.
Manning River	Antimonite, marble, marmolite, silver ores.
Port Macquarie	Braunite, gold.
Port Macquarie (near)	Gold, copper ores.
Tacking Point	Silver ores.

Mitchell.

Mangoplah	Gold.
Mittagong	Gold.
Pullitop Creek	Tinstone, wolfram, gold.

Monteagle.

Burrangong	Gold.
Grenfell	Gold, iron pyrites, magnesite, pyromorphite, silver ores, tinstone, amethyst.
Kennedy's Creek	Chromite.
Lambing Flat	Kaolin, tinstone, gold.
Narellan Creek	Goethite.
Tyagong	Gold.
Young	Galena, gold, tourmaline.

Mouramba.

Nymagee	Copper ores, vivianite.

Murchison.

Angular Creek	Chromite.
Bald Rocks	Tinstone.
Bingera	Adamantine spar, albite, antimonite, bismuth, bismuthite, bronzite, copper ores, chromite, diallage, diamond, diaclasite, eisenkiesel, gold, garnet, jasper, kyanite, limonite, magnesite, mispickel, molybdenite, osmiumiridium, pyrites, picrolite, rock crystal, sapphire, serpentine, spinelle, tellurium, tinstone, titaniferous iron ores, topaz, tourmaline, zircon, gold.
Bingera Creek	Chromite, gold.
Curangora	Asbestos, native lead.
Gineroi	Antimonite.
Gundalmulda Creek	Chromite.
Myall Creek	Tinstone, calcite.
Reedy Creek	Chromite, copper, elaterite, galena, halloysite, prehnite, tinstone.
Two-mile Flat	Chrysolite.

Murray.

Boro	Hæmatite, manganese.
Bungendore	Braunite.
Brooks' Creek	Silver ores.
Camberra Plains	Galena.
Cotter's River	Arragonite, copper ores, eisenkiesel.
Lake George	Jasper.
Modbury Creek	Chiastolite.
Molonglo River	Silver ores, wulfenite.
Mountain Creek	Silver ores.
Murrumbidgee River	Galena, silver ores, gold.
Queanbeyan	Chlorite, marble, silver ores.
Queanbeyan River	Copper ores.
Reedy Creek	Galena.

Northumberland.

Anvil Creek	Coal.
Ash Island	Gypsum.
Brisbane Water	Hæmatite, pisolitic iron ore.
Buttar Ranges	Limonite.
East Maitland	Coal.
Glebe	Coal.
Greta	Coal, torbanite.
Lake Macquarie	Coal, torbanite.
Lambton	Coal.
Newcastle	Coal.
Plattsburg	Coal.
Redhead	Coal.
Russell's Mine	Coal.
Shepherd's Hill	Hæmatite.
Singleton	Coal, gypsum.
Teralba	Coal.
Tighe's Hill	Coal.
Tuggerah Beach Lake	Yenite.
Wallsend	Coal.
Waratah	Coal, hydrocarbon.
West Maitland	Agate, carnelian, chalcedony, goethite.

Parry.

Bowling Alley Point	Bronzite, diallage, garnet, gold, mica, native copper, zircon.
Clear Creek	Magnetite.
Hanging Rock	Chromite, gold, native lead, serpentine.
Nundle	Antimonite, copper ores, gold.
Nundle Creek	Chromite, sapphire.
Peel River	Antimonite, arragonite, copper-nickel, galena, gold, marmolite, native lead, rock crystal, sapphire, serpentine, marble.

Phillip.

Jungemonia and Uranbeen (between)	Hornblende, steatite, talc.
Eumbi and Bimbijong (between)	Ruby.
Cadell's Reef	Scorodite.
Canadian Lead	Gold.
Cooyal	Goethite, magnetite, rock-crystal, gold.
Cudgegong River	Anatase, arragonite, brookite, cinnabar, diamond, gypsum, jasper, limonite, mercury, orthoclase, ruby, sapphire, spinelle, titaniferous iron, topaz, zircon, and other gem-stones, gold.
Dabee	Alunogen, epsomite, Thomsonite.
Glenlyon	Rock-crystal.
Goree	Epidote.
Great Mullen Creek	Chrysolite, ruby.
Gulgong	Albite, asbestos, calcite, chalcedony, chalybite, chlorite, chondrodite, chromite, epidote, galena, garnet, gold, iron pyrites, kaolin, magnesite, marble, mimetite, mispickel, opal, topaz.
Guntawang	Pyroxene, gold.
Havilah	Chalcedony, marble, gold.
Home Rule	Felspar, opal, orthoclase, rock crystal, gold, ochre.
Jordan's Hill	Opal.
Lawson's Creek	Galena, opal, orthoclase, ruby, sapphire, and other gemstones.
Rats' Castle Creek	Chalcedony, ruby, wavellite, hornblende.
Tallawang	Gold.
The Lagoons	Hypersthene.
Two-mile Flat, nr. Mudgee	Brookite, carbonaceous earth, coal, chromite, epsomite, gold, grossularite, halloysite, jasper, magnesite, marble, muscovite, osmiumiridium, orthoclase, pleonaste, rock crystal, tinstone, titaniferous iron, topaz, torbanite.

Pottinger.

Gunnedah	Antimonite, calcite, cervantite, chalcedony, gold.

Richmond.

Gordon Creek	Tinstone.
Gordon Brook	Anthracite, chromite, copper ores.
Kayon	Pleonaste.
Monaltrie	Chalcedony, quartz, siliceous sinter.
Richmond River	Cimolite, gold, jasper, meerschaum, opal.
Richmond River (on the Gold coast).	Platinum.

Robinson.

Cobar	Copper ores, native bismuth, opal, gold.

Rous.

Ballina (near)	Diamond.
Richmond River	Coal.
Coast, along	Gold.

Roxburgh.

Cullen Bullen	Alunogen, copper ores, epsomite.
Mitchell's Creek	Barytes, copper ores, fluorspar, galena, gold, magnetite, pyromorphite, marble, wad.
Palmer's	Antimonite.
Pink's Creek	Copper, ribbon-jasper, sapphire.
Rylstone	Albite, antimonite, braunite, manganblende.
Sofala	Antimonite, gold.
Turon River	Diamond, epsomite, gold, tinstone.
Two-mile Creek	Chromite.
Wattle Flat	Mispickel.

Sandon.

Armidale	Antiminite, gold, manganese, native bismuth, bismuthite.
Ben Lomond	Sapphire.
Dangar's Falls	Antimony.
Gara	Antimonite, cervantite.
Uralla	Adamantine spar, antimonite, chromite, diamond, garnet, goethite, gold, hornblende, opal, rockcrystal, rutile, sapphire, spinelle, tinstone, tourmaline, titaniferous iron, schorl, topaz, zircon.

Selwyn.

Burra Creek	Tinstone.
Pilot Reef	Gold.
Tumberumba Creek	Gold.
Tumut River	Cachalong.

St. Vincent.

Araluen	Gold, silver ores.
Armprior	Marble, chiastolite.
Braidwood	Galena, gold, opal, silver, zinc.
Broad Gully	Gold.
Carwary	Hæmatite.
Carwell	Calcite, goethite, hæmatite, hydrotalcite, opal.
Jervis Bay	Goethite.
Jineroo Mount	Copper ores, galena.
Major's Creek	Galena, zinc blende, gold, pyrites, hornblende.
Monga	Gold, silver ores.
Pigeon House	Pyroxene.
Shoalhaven River	Alunogen, antimonite, chrysolite, copper ores, diamond, emerald, epidote, galena, lignite, magnesite, marcasite, mispickel, platinum, tinstone, zircon, gold.
Talwal Creek	Galena.
Yalwal Creek	Galena, platinum, gold.

Tongowoko.

Granite Diggings	Gold, tin.

Urana.

Urana	Gold.

Vernon.

Apsley River	Copper, marmolite.
Apsley	Copper ores.
Ellenborough River	Wad.
Walcha	Chalcedony, gold.

Wallace.

Adaminaby	Tinstone, gold.
Kiandra	Emerald, copper ores, galena, gold, iron pyrites, lignite, molybdenite muscovite, psilomelane, zircon.
Manner's Creek	Tinstone.
New Chum Hill	Gold.
Seymour	Copper ores.
Snowy Mountain	Idocrase.
Snowy River	Sapphire, gold.
Whipstick Flat	Gold.

Wellesley.

Bibbenluke	Barytes.
Bombala	Galena, gold, copper.
Cambalong	Barytes, galena.
Delegate	Gold.
Merinoo	Barytes.
Quedong Mount	Copper ores, galena.
Slaughterhouse Creek	Barytes.

Wellington.

Avisford	Zoisite.
Bald Hills	Agate, corrundum, diamond, maganese, rutile.
Bell River	Sapphire, topaz, and other gemstones.
Bell River and Guano Hill (between).	Eisenkiesel.
Burroba Creek	Abestos.
Burraga	Copper.
Burrandong	Anatase, brookite, diamond, gold.
Campbell's Creek	Jamesonite.
Canoblas Mount	Barytes, copper ores, gold.
Crudine Creek	Antimonite, gold.
Dowagarang	Nephcline, smaragdite.
Hargraves	Gold.
Hargraves Falls	Antimonite.
Hargraves (40 miles W. of)	Barytes.
Hawkins Hill	Gold, pyrrhotiue, muscovite, corundum, chabasite, olivinc.
Hill End	Gold, wad.
Ironbark	Chromite, gold.
Jordan's Hill	Arragonite, chalybite.
Lewis Ponds Creek	Asbestos, copper ores, epidote, magnesite, gold.
Louisa Creek	Brucite, cadmium, chrysolite, copper ores, gold, löllingite, magnesite, mispickel, native arsenic, opal, pyrolusite, realgar, scorodite, sulphur, zinc blende.
Lucknow	Asbestos, copper ores, gold, picrolite, mispickel, serpentine.
Merrendec	Actinolite, hornblende.
Meroo Creek	Gold.
Monkey Hill	Diamond.
Nuggetty Gully Creek	Jamesonite.
Ophir	Emerald, galena, gold, platiuum, titaniferous iron.
Ophir Creek	Gold.
Orange	Marble, mispickel, muscovite, silver ores, wad, zinc blende.
Pyramul	Antimonite, cervantite, gold.
Pyramul Creek	Diamond, gold.
Sally's Flat	Diamond, gold.
Spring Creek	Tinstone.
Sugarloaf Hill	Mimetite.
Sunny Corner	Zinc blende, gold, galena, silver ores, copper ores.
Tambaroora	Gold, opal.
Two-mile Flat	Gold, diamond, sapphire, and other gemstones.
Wellbank	Copper ores.
Wellington	Agate, braunite, chalcedony, copper ores, galena, gold, marble, opal, titaniferous iron, wad.
Wellington Caves (near)	Copper ores, marble.
Windeyer	Gold.

Wentworth.

Wentworth	Asbestos.

Werunda.

Salt Lake	Salt.

Westmoreland.

Essington	Copper ores.
Fish River	Gold, garnets.
Fish River Caves	Marble, saltpetre.
Native Dog Creek	Gold, sapphire, and other gemstones.
Oberon	Copper ores, diamond, epidote, pyroxene, gold.
O'Connell	Hæmatite, opal.
Sewell's Creek	Gold, specular iron, asbestos.
Wisemau's Creek	Antimonite, copper ores, galena, platinum, zinc blende, gold.
Wisemau's South	Copper ores, fluorspar, gold.

Wynyard.

Adelong	Copper ores, gold, iron pyrites, scheelite, silver ores, stilbite, zinc blende.
Adelong Creek	Gold.
Cowarbee Mine	Gold.
Stony Creek	Copper ores, gold, halloysite, torbanite.
Tarcutta	Alunogen, sulphur, tourmaline, gold.
Tarrabandra	Marble.
Tumberumba	Ruby, sapphire, gold.
Wagga Wagga	Titaniferous iron.

Yancowinna.

Umberumba Creek	Galena.

Miscellaneous.

Abingdon	Tinstone.
Alum Creek	Alunogen.
Armstrong Mine	Copper ores.
Belubula and Lachlan Rivers (between).	Barytes.
Bogan and Lachlan Rivers (between).	Geothite, tin.
Burramungie and Morowat Rivers (between).	Tourmaline.
Billabong	Tinstone.
Blair Hill	Tinstone.
Bloomfield	Opal.
Bocoble	Copper ores, gold.
Bogan River	Gypsum, magnetite.
Boorolong	Antimonite.
Britannia Mine	Diamond, tinstone, sapphire, and other gems.
Broadwater	Muscovitc.
Brownlea	Silver ores.
Bullakabit	Amethyst.
Bullanamang	Tourmaline.
Bundian	Epidote, orthoclase.
Butchart Mine	Tin ores.
Callalia Creek	Agalmatolite, pyroxene.
Castlereagh River	Opal, carnelian.
Chichester River	Galena.
Collingwood	Oligoclase, gold.
Combullanarang	Magnetite.
Conical Hills	Zeolites.
Cookaboo River	Agate.
Coolah	Ozokerite.
Coolalamine Plain	Albite.

MISCELLANEOUS—*continued.*

Copper Hill	Copper and silver ores.
Coroo	Chabasite, opal.
Courntourdra Range	Copper ores.
Cudgebegong Creek	Magnesite.
Darling River	Gypsum.
Dewelamble	Albite.
Dewingbong Mountains	Agate.
Duck Creek	Native bismuth.
Duckmaloi	Epidote, garnet, wollastonite.
Emu Creek	Gold, prehnite, scolezite.
Euroka Creek	Barytes.
Fairy Meadows	Wad.
Fish River	Oligoclase, gold.
Five-mile Flat Creek	Titaniferous iron.
Fountain Head	Chabasite.
Gobandry	Antimonite.
Golden Age Mine	Silver ores.
Goulburn Plains	Limestone.
Gunningbland	Agate.
Grampion Hills	Tinstone.
Grove Creek	Agate.
Gwydir District	Agate, chromite, diamond, epidote, jasper, limestone, sapphire.
Hall's Creek	Rose-quartz.
Hermine	Antimonite.
Honeysuckle Range	Silver ores, iron ores.
Hookanvil Creek	Opal.
Horton River	Chromite.
Hunter River District	Agate, chalcedony, chrysolite, galena, jasper, limestone, molybdenite, opal.
Illawarra District	Coal, oil shales, iron ores, chabasite, chert.
Irawang	Gypsum.
Kelly's Creek	Diallage, picrolite.
Kroombit	Copper ores.
Lachlan River	Apatite, asbestos, chabasite, chert, chlorite, goethite, halloysite, lignite, magnesite, magnetite, oligoclase, opal, pleonaste, titaniferous iron, topaz, gold.
Lake Cobham	Agate, gypsum.
Lanyon	Emerald, orthoclase.
Liverpool Plains	Arragonite, limestone.
Lowee	Chalcedony, eisenkeisel, opal, soapstone.
Jegedzeric Hill	Actinolite, epidote, tourmaline.
Macquarie River	Chrysoberyl, diamond, jasper, spinelle, topaz, zircon.
Mallone Creek	Copper ores.
Manar	Actinolite.

MISCELLANEOUS—*continued.*

Maneero	Alunogen, epidote, epsomite.
Manilla Waters	Copper ores.
Mann's River	Emerald, quartz crystal, sapphire.
Monaro	Gold.
Mookerawa Creek	Mercury, gold.
Morullan	Epidote.
Mount Dixon	Albite.
Mount Lindsay	Eisenkiesel, orthoclase.
Mount Murulla, near Murrurundi.	Wulfenite.
Mount Tennant	Emerald, epidote, tourmaline.
Mount Walker	Orthoclase.
Mowembah	Actinolite, tinstone.
Mud Wells	Natron.
Mullion Range	Lydian-stone.
Muntabilli River	Pleonaste.
Murrumbidgee River	Albite, chromite, jasper, marble, marmolite, serpentine, tourmaline, gold.
Myralla	Apophyllite.
MacIntyre River	Agate, jasper.
Namoi River	Sapphire.
New England	Bismuthite, hæmatite, hornblende, iron pyrites, magnesite, limestone, tin, topaz, tourmaline, gold, antimonite.
Nurembla	Agalmatolite.
Ournie	Mispickel, gold.
Ororal	Muscovite, opal.
Pierce's Knob	Copper ores.
Pine Bone Creek	Hæmatite.
Quialago Creek	Limestone.
Rock Flat	Arragonite.
Rocky Ridge	Kaolin.
Shellmalleer	Silver ores.
South River Range	Antimonite.
Staunifer Mine	Diamond, tin.
Tarraba	Torbanite.
Tarrago Creek	Marble.
The Alps	Tinstone.
The Gulf	Native bismuth, tin.
Towamba	Epidote.
Tweed River	Cornelian.
Waibong	Limestone.
Warrambungall Mountains	Tinstone.
Wellingrove	Silver ores.
Windindingerie Cataract	Epidote, hauyne, orthoclase.
Winterton	Native arsenic, zinc blende.
Woolgarloo	Galena, fluorspar, silver ores.
Yarrahappini	Silver ores.
Yarrangun	Muscovite.

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INDEX OF MINERALS.

LIST of Minerals mentioned in the foregoing Paper :—

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Sydney: Thomas Richards, Government Printer.—1882.

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